

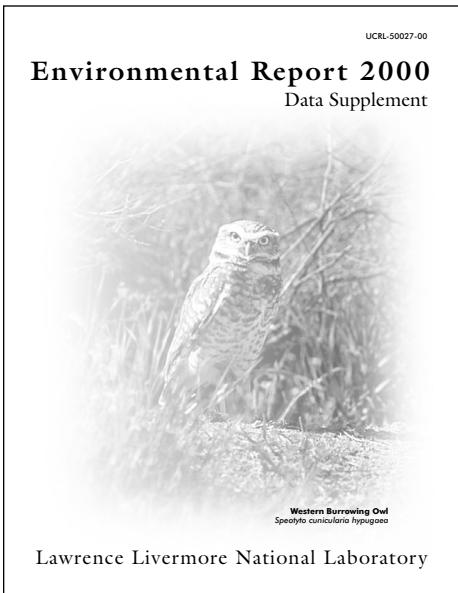
Environmental Report 2000

Data Supplement



Western Burrowing Owl
Speotyto cunicularia hypugaea

Lawrence Livermore National Laboratory



Cover

The western burrowing owl (*Speotyto cunicularia hypugaea*) is listed as a species of Concern on both a state and federal level and has nearly vanished from its historic range in the San Francisco Bay Area. This small owl, approximately 9 inches tall, has cryptic coloration and can be found nesting underground in prairie, agricultural, and desert habitats of western North America. The owl commonly perches on top of the mound outside its burrow and may be visible in the day or at night. The diet of the burrowing owl in the Bay Area typically consists of beetles and Jerusalem crickets in the summer and mice during the winter.

Site 300 hosts a small but significant population of burrowing owls that have adapted to the grassland habitat of the Altamont Pass area with its steeply angled slopes and ground features. Owl pairs on site express strong fidelity toward nest sites. In the spring, they can be found nesting in inactive badger dens and guarding a 2- to 3-acre foraging territory surrounding the den. The owl is protected at both Site 300 and the Livermore main site; exclusion zones are posted annually around active burrows to prevent adverse impacts from laboratory activities. Owls nesting in the northern buffer zone of the main site have not been sighted in several years.

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Owls in northern California are considered migratory while other populations in central and southern California are predominately nonmigratory. Site 300 appears to be in a transition zone and both migratory and nonmigratory owls are thought to be present. LLNL wildlife biologists have recently color-banded some breeding owls at Site 300 to collect information on pair bonds and distribution unique to this area.

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Environmental Report 2000

Data Supplement

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September 1, 2001

Lawrence Livermore National Laboratory
UCRL-50027-00

Distribution Category UC-702



PREFACE

This Data Supplement to the Lawrence Livermore National Laboratory's (LLNL's) annual *Environmental Report 2000* was prepared for the U.S. Department of Energy. The main volume is intended to provide all information on LLNL's environmental impact and compliance activities that is of interest to most readers. The Data Supplement supports main volume summary data and is essentially a detailed data report that provides individual data points, where applicable. Some summary data are also included in the Data Supplement, and more detailed accounts are given of sample collection and analytical methods.

The two volumes are organized in a parallel fashion to aid the reader in cross-referencing between them. This supplement includes more

detailed information to support the nine chapters in the main volume that cover monitoring of air surveillance, air effluent, sewerable water, surface water, groundwater, soil and sediment, vegetation and foodstuff, environmental radiation, and quality assurance. The other five chapters in the main volume have no supporting information in the Data Supplement.

As in our previous annual reports, data are presented in Système International (SI) units. In particular, the primary units used for radiological results are becquerels and sieverts for activity and dose, with curies and rem used secondarily ($1 \text{ Bq} = 2.7 \times 10^{-11} \text{ Ci}$; $1 \text{ Sv} = 100 \text{ rem}$).

Table of Contents

List of Tables	vi
1. Site Overview.....	1-1
2. Compliance Summary.....	2-1
3. Environmental Program Information.....	3-1
4. Air Effluent Monitoring	4-1
Air Effluent Sampling Methods	4-1
Data	4-2
5. Air Surveillance Monitoring.....	5-1
Air Surveillance Sampling	5-1
Air Particulate Networks	5-1
Air Particulate Radiological Networks	5-2
Air Particulate Beryllium	5-3
Air Tritium	5-4
Data	5-4
6. Sewerable Water Monitoring.....	6-1
Discharges of Treated Groundwater	6-1
Flow Monitoring Methods	6-1
Sewage Sampling Methods and Analytical Procedures	6-1
Quality Assurance Methods	6-3
7. Surface Water Monitoring.....	7-1
Introduction	7-1
Storm Water	7-1
Rainfall.....	7-1
Drainage Retention Basin.....	7-2
Other Waters	7-2
8. Groundwater Investigation and Remediation.....	8-1
9. Groundwater Monitoring.....	9-1
Methods	9-1
Livermore Site	9-2
Site 300.....	9-2
10. Soil and Sediment Monitoring.....	10-1
Surface Soil Methods	10-1
Surface Sediment Methods	10-2
Vadose Zone Soil Methods	10-2
Data	10-3

 Indicates no supplemental data in this volume. Please see the main volume for detailed information on this subject.

11.	Vegetation and Foodstuff Monitoring	11-1
	Introduction	11-1
	Vegetation Sampling Methods.....	11-1
	Wine Sampling Methods.....	11-2
12.	Environmental Radiation Monitoring	12-1
	Methods of Gamma Radiation Monitoring	12-1
	Tables	12-2
13.	Radiological Dose Assessment.....	13-1
14.	Quality Assurance	14-1
	Laboratory Intercomparison Studies.....	14-1



Indicates no supplemental data in this volume. Please see the main volume for detailed information on this subject.

List of Tables

Table 4-1.	Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 175, 2000.....	4-3
Table 4-2.	Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 177, 2000.....	4-3
Table 4-3.	Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 2000.....	4-4
Table 4-4.	Summary of tritium in air effluent samples from monitored emission points at Building 331, 2000.....	4-6
Table 4-5.	Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 332, 2000.....	4-7
Table 4-6.	Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 491, 2000.....	4-8
Table 5-1.	Monthly median activities for gross alpha and gross beta summarized from weekly data for the LLNL perimeter locations, 2000	5-6
Table 5-2.	Monthly median activities for gross alpha and gross beta summarized from weekly data for the Livermore Valley upwind locations, 2000	5-7
Table 5-3.	Monthly median activities for gross alpha and gross beta summarized from weekly data for Livermore Valley downwind, 2000	5-8
Table 5-4.	Gamma activity in particulate air samples, Livermore site perimeter, 2000	5-9
Table 5-5.	Plutonium-239+240 activity in air particulate samples, Livermore site perimeter, 2000	5-10
Table 5-6.	Plutonium-239+240 activity in air particulate samples, Livermore Valley, 2000	5-11
Table 5-7.	Uranium mass concentration in air particulate samples, LLNL Livermore site composite, 2000.....	5-13
Table 5-8.	Monthly median activities for gross alpha summarized from weekly data from low-volume air samplers, 2000	5-14
Table 5-9.	Monthly median activities for gross beta summarized from weekly data from low-volume air samplers, 2000	5-15
Table 5-10.	Tritium concentration in air, Livermore Valley, 2000	5-16
Table 5-11.	Tritium concentration in air, Livermore site perimeter, 2000	5-17
Table 5-12.	Tritium concentration in air at locations near diffuse sources, 2000	5-18
Table 5-13.	Monthly beryllium in air particulate composites, Livermore site perimeter, 2000	5-19
Table 5-14.	Monthly median activities for gross alpha and gross beta summarized from weekly data for Site 300 perimeter and off-site locations, 2000	5-20

Table 5-15.	Gamma activity in particulate air samples, Site 300, 2000.....	5-21
Table 5-16.	Plutonium-239+240 activity in air particulate samples, Site 300 composite, 2000	5-22
Table 5-17.	Uranium mass concentration in air particulate samples, Site 300, 2000.....	5-23
Table 5-18.	Tritium concentration in air, Site 300, 2000.....	5-28
Table 5-19.	Beryllium in air particulate samples, Site 300 network, 2000	5-29
Table 6-1.	Laboratory analytical results for groundwater discharges to the sanitary sewer, January 1 through December 31, 2000.....	6-4
Table 6-2a.	Daily flow totals for Livermore site sanitary sewer effluent (ML), 2000.....	6-5
Table 6-2b.	Monthly and annual flow summary statistics for Livermore site sanitary sewer effluent (ML), 2000.....	6-6
Table 6-3.	Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000	6-7
Table 6-4.	Weekly composite results for tritium (mBq/mL) for the LWRP effluent, 2000	6-18
Table 6-5.	Weekly composite results for metals in LLNL sanitary sewer effluent, 2000	6-19
Table 6-6.	Monthly 24-hour composite results for metals in LLNL sanitary sewer effluent, 2000	6-21
Table 6-7.	Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000	6-22
Table 7-1.	Routine tritium, gross alpha, and gross beta sampling in storm water runoff at the Livermore site, 2000	7-3
Table 7-2.	Special tritium source investigation sampling in storm water runoff (Bq/L) at the Livermore site, 1999-2000	7-5
Table 7-3.	Plutonium in storm water runoff, Livermore site, 2000.....	7-6
Table 7-4.	Metals detected in storm water runoff, Livermore site, 2000	7-7
Table 7-5.	Nonradioactive constituents (other than metals) detected in storm water runoff, Livermore site, 2000	7-9
Table 7-6.	Number of nondetects in storm water runoff, Livermore site, 2000	7-10
Table 7-7.	Radioactivity in storm water runoff, Site 300, 2000	7-13
Table 7-8.	Nonradioactive constituents in storm water runoff, Site 300, 2000	7-14
Table 7-9.	Dioxins in storm water runoff, Site 300, 2000.....	7-15
Table 7-10.	Tritium in rain (Bq/L), Livermore site, Livermore Valley, and Site 300, 2000	7-16
Table 7-11.	Drainage Retention Basin discharge limits for CDBX, identified in CERCLA Record of Decision as amended, and sampling frequencies for CDBX and WPDC.....	7-17
Table 7-12.	Routine water quality management action levels and monitoring plan for the Drainage Retention Basin.....	7-19
Table 7-13.	Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2000	7-21

Table 7-14. Compliance monitoring data for releases from the Drainage Retention Basin, dry season, 2000	7-27
Table 7-15. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000	7-29
Table 7-16. Quarterly analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000	7-32
Table 7-17. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000	7-33
Table 7-18. Field data collected from the Drainage Retention Basin at eight locations, 2000	7-37
Table 7-19. Seasonal inventory of plants and animals, Livermore site, 2000.....	7-41
Table 7-20. Radioactivity in surface and drinking water (Bq/L) in the Livermore Valley, 2000.....	7-44
Table 9-1a. Analytical methods and contractual reporting limits for inorganic constituents of concern in groundwater	9-3
Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater	9-5
Table 9-2. Livermore site surveillance well W-008	9-10
Table 9-3. Livermore site surveillance well W-221	9-12
Table 9-4. Livermore site surveillance well W-017	9-14
Table 9-5. Livermore site surveillance well 14B1	9-16
Table 9-6. Livermore site surveillance well W-121	9-18
Table 9-7. Livermore site surveillance well W-151	9-20
Table 9-8. Livermore site surveillance well W-571	9-22
Table 9-9. Livermore site surveillance well W-1012	9-24
Table 9-10. Livermore site surveillance well W-556	9-26
Table 9-11. Livermore site surveillance well W-373	9-28
Table 9-12. Livermore site surveillance well W-204	9-30
Table 9-13. Livermore site surveillance well W-363	9-30
Table 9-14. Livermore site surveillance well W-1308	9-31
Table 9-15. Livermore site surveillance well W-1303	9-32
Table 9-16. Livermore site surveillance well W-119	9-33
Table 9-17. Livermore site surveillance well W-1306	9-33
Table 9-18. Livermore site surveillance well W-906	9-34
Table 9-19. Livermore site surveillance well W-593	9-34
Table 9-20. Livermore site surveillance well W-270	9-35
Table 9-21. Livermore site surveillance well W-359	9-36
Table 9-22. Livermore site surveillance well GSW-011	9-37

Table 9-23. Livermore site surveillance well W-307	9-38
Table 9-24. Livermore site surveillance well W-226	9-39
Table 9-25. Livermore site surveillance well W-306	9-40
Table 9-26. Livermore site surveillance well W-305	9-41
Table 9-27. Livermore site surveillance well SIP-331-001.....	9-41
Table 9-28. Livermore site surveillance well W-148	9-42
Table 9-29. Tritium activities in selected Livermore site surveillance wells, 2000.....	9-43
Table 9-30. Tritium activity in Livermore Valley wells, 2000	9-44
Table 9-31. Nitrate concentrations in selected Livermore site surveillance wells, 2000.....	9-45
Table 9-32. Site 300, Elk Ravine surveillance wells	9-46
Table 9-33. Site 300, Pit 2 surveillance wells	9-49
Table 9-34. Site 300, Pit 8 surveillance wells	9-51
Table 9-35. Site 300, Pit 9 surveillance wells	9-52
Table 9-36. Analytical results for Site 300 Building 829 area deep monitoring wells, 2000.....	9-53
Table 9-37. Analytical results for Site 300 Building 829 area shallow monitoring wells, 2000.....	9-59
Table 9-38. Site 300 potable standby supply well 18	9-59
Table 9-39. Site 300 potable supply well 20.....	9-60
Table 9-40. Site 300 off-site well CARNRW1	9-61
Table 9-41. Site 300 off-site well CDF1.....	9-62
Table 9-42. Site 300 off-site surveillance well CON1	9-63
Table 9-43. Site 300 off-site surveillance well GALLO1	9-64
Table 9-44. Site 300 off-site surveillance well CARNRW2.....	9-65
Table 9-45. Site 300 off-site surveillance well CON2	9-66
Table 9-46. Annually monitored off-site surveillance wells.....	9-67
Table 10-1. Radionuclides in soils and sediments in the Livermore Valley, 2000.....	10-4
Table 10-2. Radionuclides and beryllium in soils at Site 300, 2000	10-6
Table 10-3. Background screening concentration values for metals in soils at the Livermore site	10-7
Table 10-4. De minimis concentration levels for organic and radioactive constituents of concern found in Livermore site soils and sediments.....	10-8
Table 10-5. Volatile organinc compounds measured by EPA Method 1311, followed by Method 8260 in Livermore site vadose zone soil, 2000.....	10-9
Table 10-6. Total metals in Livemore site vadose zone soil, 2000.....	10-10
Table 10-7. Soluble metals in Livermore site vadose zone soil, 2000	10-11
Table 11-1. Concentrations of tritium in plant water (Bq/L) collected quarterly from various sampling locations, 2000.....	11-3

Table 11-2. Tritium in retail wine (Bq/L), 2000.....	11-4
Table 12-1. Calculated dose from TLD environmental radiation measurements, Livermore site perimeter, 2000.....	12-3
Table 12-2. Calculated dose from TLD environmental radiation measurements, Livermore valley, 2000.....	12-4
Table 12-3. Calculated dose from TLD environmental radiation measurements, Site 300 perimeter, 2000.....	12-5
Table 12-4. Calculated dose from TLD environmental radiation measurements, Tracy and other off-site locations in the vicinity of Site 300, 2000	12-6
Table 14-1. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 2000	14-2
Table 14-2. LLNL's HCAL results from the DOE EML Quality Assurance Program, 2000	14-4
Table 14-3. LLNL CES EMRL performance in the MAPEP-00-S7 Intercomparison Program for Soil	14-4
Table 14-4. LLNL CES EMRL performance in the MAPEP-99-W7 Intercomparison Program for Water	14-5



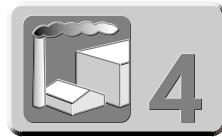
**There are no supplemental data in this chapter.
Please see the main volume for details about
Site Overview.**



**There are no supplemental data in this chapter.
Please see the main volume for details about
Compliance Summary.**



**There are no supplemental data in this chapter.
Please see the main volume for details about
Environmental Program Information.**



AIR EFFLUENT MONITORING

Paula J. Tate
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Air Effluent Sampling Methods

In 2000, Lawrence Livermore National Laboratory used 76 continuously operating radiological sampling systems on air exhausts at six facilities at the Livermore site (see main volume, **Table 4-1**). These samplers were used to determine actual emissions from operations involving radioactive materials at the facilities and to verify the integrity of emission control systems. For a further discussion see Chapter 4 of the main volume.

Air samples for particulate emissions are extracted downstream of high-efficiency particulate air (HEPA) filters and prior to the discharge point to the atmosphere. In most cases, simple filter-type aerosol collection systems are used. However, in Buildings 332, continuous air monitors (CAMs) are used for sampling to check for alpha activity. In addition to collecting a sample of particles, the CAM units provide an alarm capability for the facility in the event of a release of particulates containing alpha activity. Both types of sampling systems, the simple filter type and alpha alarm monitors, are used to monitor discharge points from Building 332. In the event of a power outage, the air sampling systems in critical facilities are switched to auxiliary power and continue to operate.

The sample filters are 47-mm-diameter membrane filters and are changed weekly or biweekly, depending on the facility. After sample collection,

filters are placed in glassine envelopes, and each envelope is tagged with a unique bar code label. Filter sample data—including location, equipment identification, bar code, sampling start date, sampling stop date, and flow rate—are entered into the Hazards Control Department (HCD) sample tracking and reporting (STAR) computer system. Sampling procedures are contained in the environmental section of the discipline action plan for a facility. Filters are analyzed at the HCD Radiological Measurements Laboratory (RML) for gross alpha and beta activity using gas proportional counters. Analysis is delayed for at least four days following sample termination to allow for the decay of naturally occurring radon daughters. To verify the operation of the counting system, calibration and background samples are intermixed with the sample filters for analysis. Analytical techniques are consistent with the Environmental Protection Agency (EPA) recommended procedures. Further details about sampling and analysis are discussed in the *Environmental Monitoring Plan* (Tate et al. 1999).

Each stack of the Tritium Facility (Building 331) is monitored for tritium release by both a continuous monitoring alarm system and continuous molecular sieve samplers. The alarmed samplers, Overhoff ionization chambers, provide real-time total tritium concentration release levels (tritiated hydrogen gas and tritiated water combined). The sieve samplers, which can discriminate between tritiated water vapor and tritiated hydrogen gas,



provide the values used for environmental reporting. Each sieve sampler (not alarmed) runs in parallel with an alarmed monitor and consists of two molecular sieves. The first sieve collects tritiated water vapor; the second sieve contains a palladium-coated catalyst that converts tritiated hydrogen to tritiated water and collects the tritiated water on the sieve. Sieves are changed weekly. The sieve samples are logged into the HCD STAR sample tracking system and submitted to the HCD Analytical Laboratory, where tritiated water is baked out and collected. RML analyzes the retrieved tritium for beta activity using scintillation counting techniques.

tables present the ratio of the number of results that have activity concentration greater than the analysis' minimum detectable concentration (MDC) to the total number of samples in the year, and the minimum, median, and maximum activity concentrations of the samples (in Bq/m³). The MDC is defined as the smallest concentration of radioactive material that can be detected (distinguished from background) with some specified degree of confidence. Analytical results are reported as a measured concentration in Bq per volume of air. If the concentration reported is negative, the result is considered to be a nondetection (see Chapter 14).

Data

Annual summaries of gross alpha, gross beta, and tritium data for samplers at each monitored facility are summarized in Tables 4-1 through 4-6. The

Table 4-1. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 175, 2000

Emission point	No. >MDC ^(a) /total samples	Minimum (10^{-6} Bq/m 3)	Median (10^{-6} Bq/m 3)	Maximum (10^{-6} Bq/m 3)
Gross alpha				
1	4/52	-51.8	32.6	3690
2	2/52	-59.2	27.4	2380
3	2/52	-34.9	2.72	2340
4	1/52	-31.7	3.43	614
5	0/52	-67.7	7.42	89.5
6	0/52	-74.7	-7.66	149
Gross beta				
1	37/52	-57.4	507	5660
2	14/52	-79.9	262	3660
3	10/52	-84.0	94.9	2980
4	1/52	-92.9	-0.26	703
5	0/52	-157	17.9	286
6	1/52	-215	44.6	518

a MDC = Minimum detectable concentration. (See main volume, Chapter 14, for an explanation of MDC.)

Table 4-2. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 177, 2000

Emission point	No. >MDC ^(a) /total samples	Minimum (10^{-6} Bq/m 3)	Median (10^{-6} Bq/m 3)	Maximum (10^{-6} Bq/m 3)
Gross alpha				
1	1/52	-39.6	-10.0	189
Gross beta				
1	1/52	-104	11.4	225

a MDC = Minimum detectable concentration. (See main volume, Chapter 14, for an explanation of MDC.)



Table 4-3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 2000

Emission point ^(a)	No. >MDC ^(b) /total samples	Minimum (10 ⁻⁶ Bq/m ³)	Median (10 ⁻⁶ Bq/m ³)	Maximum (10 ⁻⁶ Bq/m ³)
Gross Alpha				
1	1/26	-40.3	57.5	342
3	1/26	-22.7	30.8	175
5	3/26	-25.8	41.1	171
6	1/26	-47.0	73.8	337
7	0/26	-11.3	26.0	77.0
10	1/26	-59.6	157	688
13	0/26	-30.5	48.3	164
14	2/26	-51.1	43.5	236
16	0/26	-51.8	7.53	105
17	0/26	-24.6	52.9	196
18	0/26	-24.6	28.5	102
19	0/26	-54.4	31.2	149
20	0/26	-23.6	26.0	92.1
21	1/26	-28.3	33.0	188
23	1/26	-25.0	5.68	142
24	0/26	-92.9	25.1	245
25	0/26	-58.8	6.90	119
26	0/26	-53.3	14.9	193
28	1/26	-38.1	82.0	242
29	1/26	-15.7	22.1	168
30	0/26	-31.0	63.8	186
33	6/26	-24.2	66.8	290
34	0/26	-31.2	42.6	167
35	0/26	-39.6	13.1	107
40	1/26	-15.2	15.1	75.9
43	0/26	-12.4	3.87	50.7
44	1/26	-12.0	23.1	81.0
45	0/26	-29.8	38.1	133
46	2/26	-14.9	37.1	272
47	2/26	-5.81	44.6	131
48	3/26	-16.9	40.1	215
49	0/26	-27.5	24.4	374

**Table 4-3. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 251, 2000 (concluded)**

Emission point ^(a)	No. >MDC ^(b) /total samples	Minimum (10 ⁻⁶ Bq/m ³)	Median (10 ⁻⁶ Bq/m ³)	Maximum (10 ⁻⁶ Bq/m ³)
Gross beta				
1	1/26	-38.9	122	507
3	1/26	-48.5	89.9	352
5	9/26	-38.5	216	1410
6	2/26	-210	238	703
7	3/26	-48.1	85.3	248
10	15/26	170	672	1470
13	1/26	-56.2	164	343
14	11/26	112	378	892
16	0/26	-35.4	116	209
17	9/26	35.7	227	907
18	0/26	-54.8	111	290
19	1/26	-62.2	87.9	235
20	1/26	-41.1	85.1	285
21	18/26	138	328	1130
23	2/26	-23.4	116	385
24	0/26	-30.5	183	396
25	1/26	-113	138	322
26	1/26	-151	167	518
28	11/26	-96.9	334	2820
29	0/26	-34.2	76.0	214
30	2/26	-55.5	139	485
33	25/26	187	468	2400
34	15/26	47.0	284	918
35	0/26	-33.4	74.2	195
40	4/26	7.62	65.1	193
43	2/26	-15.7	58.3	141
44	11/26	-11.2	108	418
45	5/26	-116	193	455
46	24/26	98.8	348	1020
47	23/26	118	350	1510
48	11/26	-42.6	152	560
49	16/26	10.5	285	2280

a Results reported are from the simple, filter-type samplers (see text).

b MDC = Minimum detectable concentration. (See main volume, Chapter 14, for an explanation of MDC.)



Table 4-4. Summary of tritium in air effluent samples from monitored emission points at Building 331, 2000

Emission point ^(a)	No. >MDC ^(b) /total samples	Minimum (10^{-6} Bq/m 3)	Median (10^{-6} Bq/m 3)	Maximum (10^{-6} Bq/m 3)
HT				
Stack 1	47/52	0.00	8.97	24.7
Stack 2	52/52	132	304	5550
HTO				
Stack 1	52/52	294	814	1510
Stack 2	52/52	137	2440	43300

a Results reported are from the molecular sieve samplers (see text). The ionization chamber samplers are in place for facility alarm purposes rather than environmental reporting, so their results are not included here.

b MDC = Minimum detectable concentration. (See main volume, Chapter 14, for an explanation of MDC.)

**Table 4-5. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 332, 2000**

Emission point ^(a)	No. >MDC ^(b) /total samples	Minimum (10 ⁻⁶ Bq/m ³)	Median (10 ⁻⁶ Bq/m ³)	Maximum (10 ⁻⁶ Bq/m ³)
Gross alpha				
SP-1A	0/51	-48.8	6.07	114
SP-1B	0/51	-65.1	2.23	71.0
SP-2A	0/51	-45.9	-14.1	95.8
SP-2B	0/51	-67.0	3.21	134
SP-3	0/52	-35.9	-13.7	44.8
SP-4	0/52	-64.4	2.80	87.7
SP-5	0/52	-70.3	-12.2	64.4
SP-6A	0/52	-47.7	-3.41	42.9
SP-6B	0/52	-70.3	-12.2	135
SP-7A	0/52	-51.1	-7.16	92.1
SP-7B	0/52	-71.4	7.34	94.4
SP-8	0/52	-67.7	-15.5	107
SP-9	0/51	-70.3	7.96	87.7
SP-10	0/52	-135	1.97	177
SP-11	0/52	-64.4	1.39	110
SP-12	0/52	-104	8.70	206
Gross beta				
SP-1A	0/51	-131	11.7	351
SP-1B	0/51	-140	-1.74	159
SP-2A	0/51	-199	19.1	403
SP-2B	0/51	-102	-4.66	132
SP-3	0/52	-158	16.6	273
SP-4	0/52	-167	10.9	155
SP-5	0/52	-128	-2.78	112
SP-6A	1/52	-121	1.78	266
SP-6B	0/52	-193	15.9	263
SP-7A	0/52	-103	3.27	297
SP-7B	0/52	-175	-4.64	152
SP-8	0/52	-143	4.50	173
SP-9	0/51	-157	-11.5	119
SP-10	0/52	-437	-25.5	308
SP-11	0/52	-167	-1.26	160
SP-12	1/52	-260	-5.99	570

a Results reported are from the simple, filter-type samplers (see text). The continuous air monitor samplers are in place for facility alarm purposes rather than environmental reporting, so their results are not included here.

b MDC = Minimum detectable concentration. (See main volume, Chapter 14, for an explanation of MDC.)

**Table 4-6. Summary of gross alpha and gross beta in air effluent samples from monitored emission points at Building 491, 2000**

Emission point	No. >MDC ^(a) /total samples	Minimum (10^{-6} Bq/m 3)	Median (10^{-6} Bq/m 3)	Maximum (10^{-6} Bq/m 3)
Gross alpha				
1	1/52	-15.2	2.09	138
Gross beta				
1	2/52	-50.7	17.5	273

a MDC = Minimum detectable concentration. (See main volume, Chapter 14, for an explanation of MDC.)



AIR SURVEILLANCE MONITORING

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Air Surveillance Sampling

Lawrence Livermore National Laboratory conducts air surveillance sampling using several different networks, each one representing a general location and type of analysis. There are separate networks for sampling radiological particulates and beryllium particulates at both the Livermore site and Site 300 as well as a low-volume radiological air surveillance sampling network and a tritium sampling network in Livermore and one tritium sampling location at Site 300. Four different collection media are employed: glass fibers for radiological particulates, cellulose for beryllium particulates, Millipore for low-volume radiological particulates, and silica gel for tritium. **Table 5-1** in the main volume shows which sampling locations are included in each network; sampling locations are shown in **Figures 5-1, 5-2, and 5-3** in the main volume.

Air Particulate Networks

All particulate air samplers are positioned to ensure reasonable probability that any significant concentration of particulate effluents from LLNL operations will be detected.

The air particulate networks primarily use high-volume (hi-vol) air sampling units, which collect airborne particles on filters. These hi-vols use

brushless motors and provide a readout of the total elapsed time and instantaneous and total flow rates.

Mass flow totalizers in the hi-vols are checked weekly using a portable field calibration unit. If a hi-vol stops running or the measured flow rate differs more than 10% from the expected flow rate, it is recalibrated using a calibration source traceable to the National Institute for Standards and Technology (NIST). During operation, the flow rate is maintained within 10%, better than the Department of Energy (DOE) requirement of $\pm 20\%$, of the nominal flow by using a mass flow controller that adjusts motor speed. All air particulate filters are changed each week at all locations.

After each particulate filter is removed from a sampler, it is identified by location, date on, date off, elapsed time, and flow rate; and it is given a sample identifier (a four-field code) that accompanies it throughout the analysis. Filters are then placed in glassine envelopes, and the sample information is recorded in a field tracking notebook. All air filters are processed at the end of each month according to their location and required analysis.



Radiological hi-vol samplers collect particulate at a continuous rate of 1 m³/min using glass-fiber filters. The low-volume samplers collect particulate at a continuous rate of 0.03 m³/min using Millipore filters. Beryllium samplers collect particulate at a continuous rate of 0.43 m³/min using Whatman-41 cellulose filters.

The details of air particulate sampling and sample change-out are described in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1999). Details of high-volume sampler flow calibration are also discussed in a procedure (ORAD EMP-AP-CA), and details of air sample analysis are outlined in standard operating procedure provided by the analytical laboratories.

Air Particulate Radiological Networks

The collection efficiency of particulate filters for radiological analysis should be greater than 95% (Marshall and Stevens 1980). LLNL uses glass-fiber filters that have this level of efficiency and that maintain continuous flowrates. A total volume of approximately 10,000 m³ of air is sampled at each location each week for radiological analysis.

During 2000, one air sampling station, COHO, was added. This location is near the southeast perimeter of Site 300 and replaces PRIM as the site-wide maximally exposed individual (SW-MEI) for NESHAPS purposes. Both air particulate and air tritium samples are collected here.

AMON location was off-line starting in August and remains off-line due to an interruption in power. LLNL is working with PG&E to get the sampler back on-line.

Data from each of the networks are grouped in categories representing the following areas: perimeter, upwind, downwind, diffuse source (tritium only), and special interest locations.

The LLNL hi-vol radiological air particulate site perimeter network maintains seven samplers at the perimeter (CAFE, COW, CRED, MESQ, MET, SALV, and VIS), shown in the main volume

Figure 5-1. The Livermore Valley network shown in the main volume **Figure 5-2**, consists of four locations in the least prevalent wind directions (CHUR, FCC, FIRE, and HOSP), considered to be upwind or background, and four samplers located in the most prevalent downwind directions (AMON, PATT, TANK, and ZON7). An additional sampler is located upwind in an area of special interest at the Livermore Water Reclamation Plant (LWRP) because, in 1967, there was a plutonium release to the sanitary sewer that resulted in local soil contamination. The low-volume radiological air particulate network consists of two samplers located at HOSP and FCC.

Site 300 is monitored at eight locations (801E, ECP, EOBS, GOLF, NPS, WCP, WOBS, and COHO) placed around the site boundary and near onsite firing tables as shown in the main volume

Figure 5-3. Off-site monitoring at Site 300 occurs at TFIR (in downtown City of Tracy).

Glass-fiber filters are collected from the field and placed in glassine bags. The glassine bags are gathered at the end of the month, and each filter is cut and separated to supply samples for the various analyses. Portions of all glass-fiber filters are sent for gross alpha and gross beta analysis. These samples are sent to the commercial analytical laboratory after a four-day delay to allow for decay of radon-thoron daughters. Gross alpha and gross beta activities are determined using a gas flow proportional counter.

As outlined in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), gross alpha and gross beta air-filter results are used only as trend indicators; specific radionuclide analysis is done for plutonium, uranium, and gamma emitters, depending on the location. All analytical results are reported as a measured concentration per volume of air. When activity is less than the minimum detection concentration (MDC), the calculated value is reported (see Chapter 14 for further details). Particle size distributions are not determined because the estimated effective dose equivalent to the maximally exposed individual is well below the 0.01 mSv (1 mrem) allowable limit (DOE 1991).

The analytical laboratory uses thorium-230 and strontium-90 as calibration sources to determine alpha and beta counting efficiencies, respectively. Annual counting-efficiency measurements are made for each detector. Cross-checks using standards certified by the Environmental Protection Agency (EPA) are also completed periodically. Background and efficiency checks are completed daily, and a matrix and method blank are run with every batch of 20 samples. Records are kept of background and counting efficiency variations that occur in the counting equipment. The analytical laboratory reports the actual instrumentation values, including negative results, that arise when background measurements are higher than those for the filters.

Portions of the glass-fiber filters from the Livermore route locations are analyzed for the presence of plutonium-239+240. Similarly, portions of the glass-fiber filters from the Site 300 route are analyzed for the presence of uranium-235 and uranium-238. The filters are placed in a muffled furnace to reduce organic content and then dissolved in a mixture of nitric

acid and hydrochloric and/or hydrofluoric acids. Plutonium and uranium are separated by an ion-exchange process. Each separated element is purified further by ion exchange. They are then electroplated onto a stainless steel disk and analyzed by alpha spectrometry.

For gamma scanning, two site composites are created using another portion of all weekly glass fiber filters. One site composite is created for Livermore (COW, MESQ, MET, SALV, and VIS) and another for the Site 300 perimeter locations (801E, ECP, EOBS, GOLF, NPS, WCP, and WQBS). These composites are prepared for analysis in the same manner as the plutonium and uranium samples. After they are muffled and digested, they are counted for gamma-emitting radionuclides using Ge(Li) detectors.

In addition to the gamma scanning, the Livermore perimeter composite is analyzed for uranium and the Site 300 composite is analyzed for plutonium.

Replicate radiological quality assurance (QA) samples are processed to confirm the precision of the analytical results obtained from the samplers. A duplicate QA sampler is operated for two months in parallel with the permanent sampler at a given site. In addition, a trip blank is collected during each route. The QA trip blanks and QA duplicates are processed in the same manner as the routine samples and analyzed for the same radiological parameters.

Air Particulate Beryllium

Beryllium analysis requires an easily dissolvable filter with a low trace-metal background. Whatman-41 filters provide a balance between such requirements and particulate collection efficiency (Lindeken et al. 1963).



Beryllium is monitored at six Livermore perimeter locations (CAFE, COW, MESQ, MET, SALV, and VIS) as required by the Bay Area Air Quality Management District. Although there is no requirement to monitor beryllium at Site 300, as a best management practice, it is monitored at four locations (801E, EOBS, GOLF, and TFIR).

The details of air particulate sampling and sample change-out are described in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1999). Details of high-volume sampler flow calibration are also discussed in a procedure (ORAD EMP-AP-CA).

The cellulose filters from each site are halved, with one portion saved on site for archiving, and the other composited into a monthly sample (one for each location) and sent out to the analytical laboratories for analysis. The off-site analytical laboratory digests the sample, using nitric acid, hydrochloric acid, and hydrogen peroxide during various heating and cooling phases. Care is taken to prevent the sample from boiling or baking dry. The resulting solution is diluted to 50 mL with blank water and the quantity of beryllium is determined by inductively coupled plasma-mass spectrometry.

Trip blanks are collected weekly from the Site 300 and Livermore networks, and split samples are chosen from the archived portions of the routine sample filters. LLNL sends them to the analytical laboratory as blind samples to help determine the accuracy of the analytical measurement.

Air Tritium

LLNL maintains 11 continuously operating, airborne tritium samplers on the Livermore site (main volume, **Figure 5-1**), six samplers in the Livermore Valley (main volume, **Figure 5-2**), and one at Site 300

(main volume, **Figure 5-3**). Four of the Livermore site locations (B292, B331, B514, and B624) monitor diffuse source emissions. The tritium samplers, operating at a flow rate of 700 cm³/min, use a continuous vacuum pump to capture air moisture on silica gel contained in sampling flasks. These flasks are changed every two weeks, and the samples are identified by location, date on, date off, elapsed sampling time, and flow rate. LLNL has incorporated new flow meters to each of the sampling units. These flow meters provide the instantaneous flow rate and the minimum, maximum and total flow during the sample period. The flow rate is verified biweekly with a rotameter that is calibrated once a year.

Each sample is given a sample identifier that accompanies it through analysis. Two additional samplers are rotated among the locations at two-month intervals to provide duplicate QA samples. Details of the actual tritium sampling and a description of tritium sampler calibration can be found in Appendix B of the *Environmental Monitoring Plan* (Tate et al. 1999).

Once the samples are taken, water is separated from the silica gel by freeze-dried vacuum distillation, and the tritium concentration in the water is determined by liquid-scintillation counting. Airborne tritium sample analysis is done by LLNL's Chemistry and Materials Science Environmental Services Laboratory. All analytical results are reported as a measured concentration per unit volume of air flow through the sampling medium. Details of the analytical procedure are described in Low-Level Tritium Analysis—Freeze Dry.

Data

Monthly summaries of gross alpha and gross beta data for the main site and Site 300 are presented in Tables 5-1, 5-2, 5-3, and 5-14. The activities

shown in the tables displaying monthly medians are concentrations calculated from samples collected weekly. Tables 5-4 and 5-15 present monthly gamma activity on air filters for the Livermore site perimeter and Site 300. Monthly plutonium data for each sampling location are shown in Tables 5-5, 5-6, and 5-16. Monthly uranium data for the Livermore site perimeter and Site 300 are presented in Tables 5-7 and 5-17. The monthly low-volume gross alpha and gross beta data are presented in Tables 5-8 and 5-9. Biweekly tritium data for sampling locations in the Livermore Valley, Livermore site perimeter, and diffuse sources are

shown in Tables 5-10, 5-11, and 5-12. Table 5-18 shows tritium-in-air data for Site 300. Tables 5-13 and 5-19 present monthly beryllium data for Livermore site perimeter and Site 300 sampling locations. The activities shown in the tables displaying monthly and biweekly data are measured concentrations and their associated $\pm 2\sigma$ counting errors.

The data generally reflect historic data values for these analytes at these locations. A detailed discussion of these results is provided in the main volume of this report.

**Table 5-1. Monthly median activities for gross alpha and gross beta summarized from weekly data for the LLNL perimeter locations, 2000**

Month	Sampling location ^(a)						
	CAFE	COW	CRED	MESQ	MET	SVL	VIS
	(10 ⁻⁶ Bq/m ³)						
Gross alpha							
Jan	41.1	42.6	— ^(b)	87.7	41.4	64.4	75.9
Feb	50.2	33.0	27.3	30.8	25.5	30.4	28.1
Mar	22.8	20.1	20.7	22.1	16.8	18.3	32.7
Apr	52.8	56.8	79.5	53.1	30.3	52.9	38.1
May	28.4	29.4	31.5	48.0	31.9	37.0	43.1
Jun	37.1	33.1	53.8	48.7	30.0	52.5	48.5
Jul	88.5	75.7	72.5	80.2	80.8	81.2	66.7
Aug	77.3	77.5	77.3	100	71.5	78.4	70.8
Sep	120	120	130	110	130	120	110
Oct	72.4	74.3	110	85.5	56.6	63.5	78.4
Nov	93.7	96.3	98.5	93.8	120	130	110
Dec	170	150	140	140	150	150	160
Annual median^(c)	70.9	74.3	72.5	77.7	71.9	68.2	64.7
IQR^(c,d)	49.2	65.6	57.7	57.6	69.1	61.5	60.8
Annual maximum^(c)	327	263	351	260	301	396	345
Gross beta							
Jan	470	389	— ^(b)	529	437	548	496
Feb	259	215	284	261	218	253	205
Mar	276	262	278	260	306	251	270
Apr	341	278	268	308	301	311	338
May	269	227	253	240	277	264	305
Jun	361	333	474	314	389	448	371
Jul	331	255	281	312	345	336	299
Aug	370	360	424	445	396	391	399
Sep	676	631	806	758	687	724	755
Oct	646	598	665	615	641	632	620
Nov	659	1030	1170	1120	1080	1050	1110
Dec	1020	828	1030	1060	975	945	963
Annual median^(c)	404	353	428	417	399	430	406
IQR^(c,d)	328	340	438	337	349	343	327
Annual maximum^(c)	1470	1740	2060	1780	1890	1810	1830

a See main volume, Figure 5-1, for the description of sampling locations.

b No samples collected, see main volume, Chapter 14.

c Summary data is determined from 52 weekly samples for the entire year.

d IQR = Interquartile range

**Table 5-2. Monthly median activities for gross alpha and gross beta summarized from weekly data for the Livermore Valley upwind locations, 2000**

Month	Sampling locations ^(a)					Special interest	
	Livermore Valley upwind						
	CHUR	FCC	FIRE	HOSP	LWRP		
(10⁻⁶ Bq/m³)							
Gross alpha							
Jan	64.8	54.4	38.1	30.2	62.2		
Feb	32.5	33.9	30.0	29.3	40.0		
Mar	15.8	27.9	26.4	30.1	34.1		
Apr	38.7	49.0	68.5	51.0	46.4		
May	20.0	42.5	33.3	34.1	44.1		
Jun	48.1	56.8	50.9	40.3	47.3		
Jul	89.6	92.9	66.6	72.3	67.3		
Aug	85.9	80.8	79.1	115	99.0		
Sep	116	137	119	127	159		
Oct	99.9	82.4	78.4	74.9	62.4		
Nov	109	115	105	87.0	112		
Dec	175	182	143	154	137		
Annual median^(b)	73.8	70.8	63.5	60.4	72.8		
IQR^(b,c)	75.6	63.9	62.3	65.9	60.7		
Annual maximum^(b)	347	335	295	287	380		
Gross beta							
Jan	426	437	448	414	377		
Feb	256	244	248	237	237		
Mar	265	281	274	280	321		
Apr	288	237	370	288	306		
May	215	247	241	256	257		
Jun	384	462	365	398	417		
Jul	360	301	309	256	306		
Aug	404	401	466	474	429		
Sep	722	738	719	620	728		
Oct	639	615	605	638	580		
Nov	1180	1240	1130	943	1190		
Dec	1080	1240	1010	945	1010		
Annual median^(b)	385	418	407	403	400		
IQR^(b,c)	358	425	310	359	337		
Annual maximum^(b)	1970	1960	1730	1700	1960		

a See main volume, Figure 5-1, for the description of sampling locations.

b Summary data is determined from 52 weekly samples for the entire year.

c IQR = Interquartile range



Table 5-3. Monthly median activities for gross alpha and gross beta summarized from weekly data for Livermore Valley downwind, 2000

Month	Sampling location ^(a)			
	AMON	PATT	TANK	ZON7
	(10 ⁻⁶ Bq/m ³)			
Gross alpha				
Jan	64.8	60.7	84.7	58.5
Feb	39.1	7.11	28.4	48.5
Mar	14.3	30.6	42.9	27.6
Apr	58.6	45.9	40.4	62.3
May	29.1	37.5	46.1	52.2
Jun	63.3	34.7	38.0	32.2
Jul	70.8	74.1	83.3	70.5
Aug	113	111	83.6	94.1
Sep	— ^(b)	113	113	124
Oct	— ^(b)	89.5	67.4	79.5
Nov	— ^(b)	88.0	80.6	79.0
Dec	— ^(b)	125	126	155
Annual median^(c)	54.0	72.5	69.9	66.6
IQR^(c,d)	45.9	56.4	57.7	47.2
Annual maximum^(c)	271	316	299	385
Gross beta				
Jan	342	422	518	507
Feb	232	267	268	258
Mar	207	263	280	282
Apr	275	282	345	372
May	276	325	239	292
Jun	425	383	376	367
Jul	333	374	346	334
Aug	544	428	466	417
Sep	— ^(b)	624	666	680
Oct	— ^(b)	636	640	591
Nov	— ^(b)	981	1130	1190
Dec	— ^(b)	920	990	1030
Annual median^(c)	322	407	437	414
IQR^(c,d)	260	297	323	300
Annual maximum^(c)	1310	1610	1860	1880

a See main volume, **Figure 5-2**, for the description of sampling locations.

b No samples collected, see main volume, Chapter 14.

c Summary data is determined from 52 weekly samples for the entire year.

d IQR = Interquartile range

Table 5-4. Gamma activity in air particulate samples, Livermore site perimeter, 2000(a)

Month	Radiological isotope						
	^{7}Be (10^{-3} Bq/m 3)	^{137}Cs	^{40}K	^{22}Na	^{226}Ra	^{228}Ra	^{228}Th
Jan	0.67 ± 0.081	0.50 ± 0.49	9.8 ± 15	0.47 ± 0.62	-1.3 ± 2.7	-0.78 ± 5.9	1.5 ± 2.9
Feb	0.77 ± 0.036	-0.051 ± 0.71	-3.6 ± 23	0.49 ± 0.77	0.39 ± 4.1	-1.8 ± 3.6	0.0 ± 1.8
Mar	0.77 ± 0.083	-0.20 ± 0.48	-6.2 ± 19	-0.53 ± 0.52	-1.7 ± 2.7	0.062 ± 4.4	-1.9 ± 2.2
Apr	0.18 ± 0.023	0.11 ± 0.52	3.4 ± 24	0.10 ± 0.56	-1.7 ± 3.9	-0.087 ± 3.3	0.17 ± 2.7
May	0.66 ± 0.073	-0.073 ± 0.74	-9.0 ± 24	0.46 ± 0.79	-1.5 ± 2.7	-1.5 ± 7.3	4.7 ± 1.6
Jun	0.96 ± 0.11	1.3 ± 1.5	4.7 ± 35	1.4 ± 1.2	-0.48 ± 4.5	2.3 ± 9.6	-3.2 ± 5.1
Jul	0.71 ± 0.098	0.12 ± 0.80	15 ± 27	1.4 ± 0.91	-4.6 ± 3.7	-1.5 ± 5.1	-3.3 ± 3.9
Aug	1.4 ± 0.059	—(b)	-1.3 ± 26	0.25 ± 0.83	3.0 ± 4.6	-4.6 ± 6.2	1.0 ± 3.5
Sep	1.7 ± 0.23	-0.16 ± 0.58	32 ± 25	0.46 ± 0.70	3.0 ± 3.4	2.3 ± 7.5	-0.18 ± 3.3
Oct	1.5 ± 0.049	-0.079 ± 0.74	-22 ± 21	0.13 ± 0.84	-1.3 ± 3.7	1.3 ± 10	-3.8 ± 3.3
Nov	0.96 ± 0.041	-0.27 ± 0.63	15 ± 20	0.47 ± 0.79	-0.26 ± 4.2	-0.57 ± 5.6	-0.061 ± 3.4
Dec	1.1 ± 0.12	0.71 ± 0.75	-31 ± 21	-0.31 ± 0.84	0.47 ± 3.7	-1.8 ± 6.9	-3.3 ± 2.0
Median	0.87	-0.051	1.1	0.46	-0.89	-0.68	-0.12
IQR ^(c)	0.48	0.43	18	0.35	2.0	1.9	3.6
Maximum	1.7	1.3	32	1.4	3.0	2.3	4.7
Percent of DCG ^(d)	5.8×10^{-5}	8.7×10^{-6}	3.2×10^{-6}	1.2×10^{-6}	2.7×10^{-3}	6.2×10^{-3}	0.31
DCG ^(e) (Bq/m 3)	1.5×10^3	15	33	37	0.11	0.037	1.5×10^{-3}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14.

a All Site 300 perimeter samples composited. See main volume, Figure 5-3, for description of sampling locations.

b No result provided by the analytical laboratory.

c Interquartile range.

d Percent of DCG is determined by using the median value unless median value is negative. When the median value is negative, the maximum value is used.

e DCG = Derived Concentration Guide (DOE 5400.5). See main volume, Chapter 13.

**Table 5-5. Plutonium-239+240 activity in air particulate samples, Livermore site perimeter, 2000**

Month	Sampling location ^(a)						
	CAFE	COW	CRED	MESQ	MET	SALV	VIS
	(10 ⁻⁹ Bq/m ³)						
Jan	30.1 ± 13.5	10.2 ± 5.88	0	16.6 ± 8.31	3.36 ± 3.36	34.1 ± 12.4	18.4 ± 7.47
Feb	-5.14 ± 5.58	3.48 ± 3.48	109 ± 21.2	-19.0 ± 18.8	3.93 ± 3.93	3.70 ± 3.70	2.71 ± 5.57
Mar	11.2 ± 6.49	8.24 ± 5.82	6.06 ± 6.05	15.5 ± 10.9	4.27 ± 4.27	19.7 ± 8.79	0
Apr	1.90 ± 3.62	6.95 ± 4.01	4.54 ± 3.21	-0.599 ± 2.99	-4.45 ± 6.01	15.2 ± 10.8	1.77 ± 3.38
May	-3.51 ± 4.41	11.5 ± 5.76	0	0	-8.55 ± -7.61	3.31 ± 3.31	0
Jun	5.26 ± 5.26	11.3 ± 5.63	6.75 ± 6.75	11.1 ± 6.67	6.57 ± 6.57	8.81 ± 6.23	3.31 ± 3.31
Jul	6.86 ± 9.52	11.4 ± 10.0	23.7 ± 20.8	-0.674 ± 6.26	7.58 ± 10.5	1.67 ± 6.21	8.36 ± 8.19
Aug	10.3 ± 11.7	8.25 ± 11.4	7.08 ± 13.9	8.56 ± 9.71	19.3 ± 16.9	29.2 ± 19.1	23.6 ± 24.0
Sep ^(b)	108 ± 89.6	120 ± 92.3	582 ± 138	85.2 ± 59.8	57.7 ± 41.1	183.0 ± 72.1	49.6 ± 45.8
Sep ^(b)	-0.276 ± 6.71	2.49 ± 6.72	na ^(c)	-0.876 ± 8.67	0.00 ± 0.77	30.1 ± 22.9	-1.14 ± 11.3
Oct	9.07 ± 18.2	0	7.67 ± 21.8	145 ± 85.0	-10.5 ± 21.0	26.8 ± 31.1	78.5 ± 64.8
Nov	23.1 ± 32.8	0	0	28.5 ± 56.9	19.9 ± 39.8	0	20.8 ± 41.9
Dec	10.9 ± 12.6	9.16 ± 18.3	21.0 ± 24.2	3.80 ± 7.61	3.38 ± 6.78	3.69 ± 7.40	15.3 ± 18.8
Median ^(d)	9.07	8.25	6.92	8.56	3.93	15.2	8.36
IQR ^(d,e)	9.30	7.82	18.3	17.2	7.58	25.5	19.0
Maximum ^(d)	108	120	582	145	57.7	183	78.5
Percent of DCG ^(d,f)	1.23×10^{-3}	1.11×10^{-3}	9.34×10^{-4}	1.16×10^{-3}	5.31×10^{-4}	2.05×10^{-3}	1.13×10^{-3}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. Zero values occur when there are no counts detected from the instrument background or the sample. See the main volume, Chapter 14.

- a See main volume, **Figure 5-1**, for sampling locations.
- b Data for all September plutonium samples was unusually high although not above DCG. Collocated air samples at the locations listed above were analyzed and are shown as the second set of values. See main volume, Chapter 5, for further details.
- c No data available.
- d For conservative measures, the summary statistics were determined using the higher of the September values.
- e IQR = Interquartile range
- f DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m³ for plutonium-239+240 activity in air. Percent DGC calculated on the median concentration.

**Table 5-6. Plutonium-239+240 activity in air particulate samples, Livermore Valley, 2000**

Month	Livermore Valley downwind locations ^(a)			
	AMON	PATT	TANK	ZON7
	(10 ⁻⁹ Bq/m ³)			
Jan	0	7.19 ± 7.39	6.84 ± 4.83	11.7 ± 6.75
Feb	0	0	3.75 ± 3.75	8.22 ± 5.82
Mar	24.2 ± 10.8	23.2 ± 9.72	7.69 ± 14.7	4.93 ± 4.93
Apr	0	8.89 ± 6.29	31.3 ± 15.6	0
May	19.5 ± 8.00	11.6 ± 5.81	3.04 ± 3.04	3.16 ± 3.16
Jun	23.6 ± 8.89	26.7 ± 10.1	5.54 ± 5.54	6.65 ± 6.65
Jul	46.6 ± 29.0	24.0 ± 16.7	5.47 ± 7.60	21.7 ± 16.1
Aug	34.8 ± 30.5	9.61 ± 13.3	6.77 ± 9.39	0
Sep ^(b)	— ^(c)	159 ± 72.1	215 ± 78.0	38.3 ± 28.9
Oct	— ^(c)	23.1 ± 46.3	64.1 ± 74.4	87.7 ± 79.3
Nov	— ^(c)	0	18.6 ± 37.4	31.8 ± 63.9
Dec	— ^(c)	-3.76 ± 7.54	-4.17 ± 18.6	0
Median	21.6	10.6	6.81	7.44
IQR^(d)	26.9	18.0	16.7	21.9
Maximum	46.6	159	215	87.7
Percent of DCG^(e)	2.91 × 10⁻³	1.43 × 10⁻³	9.20 × 10⁻⁴	1.00 × 10⁻³



Table 5-6. Plutonium-239+240 activity in air particulate samples, Livermore Valley, 2000^(a) (concluded)

Month	Livermore Valley upwind				Special Interest
	CHUR	FCC	FIRE	HOSP	
	(10 ⁻⁹ Bq/m ³)				
Jan	3.93 ± 3.93	5.84 ± 41.4	20.7 ± 7.85	2.10 ± 4.34	-3.63 ± 4.47
Feb	8.34 ± 5.90	9.52 ± 6.74	-5.14 ± 5.51	3.65 ± 3.65	12.0 ± 6.94
Mar	12.2 ± 7.03	-0.974 ± 5.41	0	18.7 ± 8.34	12.6 ± 7.30
Apr	14.1 ± 6.31	3.97 ± 7.60	0	0	6.05 ± 3.49
May	9.62 ± 6.81	35.0 ± 15.6	6.38 ± 4.51	0	16.9 ± 9.75
Jun	0	-0.860 ± 4.08	14.1 ± 6.32	0	0
Jul	2.16 ± 4.25	-0.580 ± 5.40	345 ± 55.7	9.19 ± 10.4	22.5 ± 14.7
Aug	20.9 ± 20.6	0	-4.95 ± 12.9	6.84 ± 9.48	19.1 ± 16.7
Sep	206 ± 72.0	101 ± 48.7	572 ± 148	409 ± 121	88.9 ± 80.5
Oct	185 ± 81.4	3720 ^(d) ± 467	0	24.4 ± 26.1	15.1 ± 17.5
Nov	-11.2 ± 22.4	0	0	0	0
Dec	0	3.87 ± 20.5	0	13.9 ± 16.1	0
Median	8.98	3.92	0.00	5.25	12.3
IQR^(e)	14.2	15.9	15.8	15.1	17.5
Maximum	206	3720	572	409	88.9
Percent of DCG^(f)	1.21 × 10⁻³	5.30 × 10⁻⁴	7.73 × 10⁻²	7.09 × 10⁻⁴	1.66 × 10⁻³

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. Zero values occur when there are no counts detected from the instrument background or the sample. See the main volume, Chapter 14.

- a See main volume, **Figure 5-1**, for sampling locations.
- b September data was unusually high. See Data Supplement, Table 5-5, and main volume, Chapter 5, for explanation.
- c No sample collected.
- d This high value was reanalyzed and confirmed. See main volume, Chapter 5, for explanation.
- e IQR = Interquartile range
- f DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m³ for plutonium-239+240 activity in air. Percent calculated on the median value unless median value is zero. When median value is zero, the maximum value is used.

**Table 5-7. Uranium mass concentration in air particulate samples, LLNL Livermore site composite, 2000**

Location^(a)	Month	Uranium-235^(b) (10^{-7} $\mu\text{g}/\text{m}^3$)	Uranium-238^(c) (10^{-5} $\mu\text{g}/\text{m}^3$)
COMP	Jan	-21.9 \pm 6.53	-13.4 \pm 1.28
	Feb	-5.83 \pm 6.71	-1.60 \pm 1.35
	Mar	9.68 \pm 5.83	14.3 \pm 1.62
	Apr	-13.3 \pm 4.10	-17.7 \pm 1.24
	May	-1.94 \pm 2.99	-5.17 \pm 0.930
	Jun	-10.6 \pm 5.23	0.401 \pm 1.51
	Jul	0.205 \pm 4.85	-4.80 \pm 1.89
	Aug	-2.70 \pm 6.16	-0.799 \pm 2.17
	Sep	4.29 \pm 5.25	13.9 \pm 2.70
	Oct	-7.22 \pm 8.84	-4.90 \pm 3.74
	Nov	-5.79 \pm 8.29	-9.36 \pm 4.16
	Dec	-1.20 \pm 6.62	-9.86 \pm 3.18
Median		-4.24	-4.85
IQR^(d)		7.23	8.98
Maximum		9.68	14.3
Percent of DCG^(e)		2.06×10^{-3}	4.77×10^{-2}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. Negative values occur when the instrument or filter background is greater than sample activity. See the main volume, Chapter 14.

a Livermore site composite includes samples from the perimeter locations. See main volume, **Figure 5-1**, for sampling locations.

b Uranium-235 activities in Bq/m^3 can be determined by dividing the weight in $\mu\text{g}/\text{m}^3$ by 12.5.

c Uranium-238 activities in Bq/m^3 can be determined by dividing the weight in $\mu\text{g}/\text{m}^3$ by 80.3.

d IQR = Interquartile range

e DCG = Derived Concentration Guide for activity in air of $0.3 \mu\text{g}/\text{m}^3$ for uranium-238 and $0.047 \mu\text{g}/\text{m}^3$ for uranium-235. Percent of DCG was calculated on the maximum value because the median value was negative.

**Table 5-8. Monthly median activities for gross alpha summarized from weekly data from low-volume air samplers, 2000^(a)**

Month	Livermore Valley upwind	
	FCC	HOSP
	(10 ⁻⁶ Bq/m ³)	
Jan	22.5	-1.45
Feb	45.6	21.0
Mar	49.8	20.6
Apr	36.5	37.5
May	78.4	38.1
Jun	34.5	59.6
Jul	27.2	1.22
Aug	51.9	57.0
Sep	79.9	23.0
Oct	79.6	30.6
Nov	17.7	26.8
Dec	59.8	77.7
Annual median^(b)	51.4	30.6
IQR^(b,c)	55.7	65.7
Annual maximum^(b)	291	215

a See main volume, **Figure 5-2**, for sampling locations.

b Determined by data from the 52-week period

c IQR = Interquartile range

**Table 5-9. Monthly median activities for gross beta summarized from weekly data from low-volume air samplers, 2000(a)**

Month	Livermore Valley upwind	
	FCC	HOSP
	(10 ⁻⁶ Bq/m ³)	
Jan	354	463
Feb	300	320
Mar	298	302
Apr	413	337
May	335	319
Jun	488	450
Jul	507	374
Aug	503	433
Sep	932	825
Oct	538	1010
Nov	1160	803
Dec	1420	1250
Annual median^(b)	507	463
IQR^(b,c)	403	507
Annual maximum^(b)	2530	2390

a See main volume, **Figure 5-2**, for sampling locations.

b Determined by data from the 52-week period

c IQR = Interquartile range

**Table 5-10. Tritium concentration in air, Livermore Valley, 2000**

Month	Sampling locations (a)					
	AMON	FIRE	HOSP	VET	XRDS	ZON7
	(10 ⁻³ Bq/m ³)					
Jan	7.29 ± 6.85 -11.7 ± 24.9	18.8 ± 8.92 -11.2 ± 30.0	3.85 ± 6.29 4.85 ± 23.3	20.1 ± 7.81 7.84 ± 25.8	5.33 ± 6.48 -0.481 ± 21.8	16.7 ± 8.18 5.55 ± 28.4
Feb	7.99 ± 17.0 -1.05 ± 19.9	7.44 ± 12.3 5.92 ± 18.2	-23.6 ± 21.9 —(b)	12.1 ± 13.7 3.52 ± 19.9	-4.88 ± 15.6 -15.8 ± 21.3	10.7 ± 18.0 7.44 ± 16.2
Mar	8.55 ± 12.7 3.92 ± 13.2 16.8 ± 14.5	27.1 ± 20.7 -4.03 ± 12.1 4.14 ± 14.2	-1.04 ± 11.2 1.54 ± 15.5 -6.14 ± 11.9	-14.0 ± 11.2 18.6 ± 13.1 14.3 ± 14.2	10.5 ± 13.8 4.00 ± 12.7 0.755 ± 11.6	14.2 ± 19.3 —(b) 3.48 ± 12.4
Apr	6.51 ± 11.7 -14.3 ± 16.9	-3.06 ± 10.7 7.70 ± 18.9	-4.00 ± 9.03 -5.25 ± 15.9	9.69 ± 11.0 0.225 ± 16.7	—(c) —(c)	11.0 ± 10.3 15.1 ± 17.0
May	10.8 ± 22.3 8.03 ± 19.9	-10.1 ± 23.3 -1.21 ± 21.2	11.0 ± 23.8 -8.36 ± 20.1	-3.30 ± 20.9 14.7 ± 19.6	—(c) —(c)	13.0 ± 19.6 13.5 ± 17.2
Jun	10.7 ± 17.8 -5.18 ± 22.2	14.5 ± 21.1 8.40 ± 22.5	-3.22 ± 16.3 -2.65 ± 21.7	3.74 ± 17.5 19.8 ± 23.5	—(c) —(c)	68.5 ± 18.8 31.9 ± 22.5
Jul	14.4 ± 14.8 15.1 ± 19.5	2.99 ± 13.3 3.11 ± 18.5	1.02 ± 14.4 -5.66 ± 19.0	-7.51 ± 13.4 -2.92 ± 19.0	—(c) —(c)	39.6 ± 15.1 89.2 ± 41.1
Aug	16.2 ± 14.1 4.92 ± 12.6	2.83 ± 14.2 13.0 ± 13.5	-7.36 ± 14.8 3.31 ± 16.6	1.70 ± 12.8 4.92 ± 12.8	—(c) —(c)	48.1 ± 14.7 35.3 ± 13.4
Sep	—(d) —(d)	9.55 ± 15.6 5.92 ± 20.1	3.23 ± 16.7 1.67 ± 20.7	—(b) 19.9 ± 19.5	—(c) —(c)	12.3 ± 14.2 13.0 ± 18.4
Oct	—(d) —(d)	4.66 ± 23.5 5.81 ± 14.4	9.21 ± 24.6 5.40 ± 14.0	11.6 ± 23.8 11.2 ± 14.3	—(c) —(c)	13.9 ± 24.0 17.9 ± 13.2
Nov	—(d) —(d)	5.59 ± 13.8 0.932 ± 12.3	27.6 ± 28.9 -0.840 ± 16.5	—(b) -0.331 ± 14.0	—(c) —(c)	—(b) -4.22 ± 13.4
Dec	—(d) —(d)	14.0 ± 16.5 18.5 ± 12.5	22.1 ± 28.7 —(b)	29.5 ± 17.8 —(b)	—(c) —(c)	18.0 ± 20.3 9.44 ± 12.0
Median ^(e)	7.99	5.70	0.762	7.84	0.755	14.1
IQR ^(f)	6.88	7.86	8.41	13.5	7.35	10.6
Percent of DCG ^(g)	2.2×10^{-4}	1.5×10^{-4}	2.1×10^{-5}	2.1×10^{-4}	2.0×10^{-5}	3.8×10^{-4}
Dose (mSv) ^(h)	1.7×10^{-6}	1.2×10^{-6}	1.6×10^{-7}	1.6×10^{-6}	1.6×10^{-7}	2.9×10^{-6}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error), or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14.

a See main volume, **Figure 5-2**, for sampling locations.

b No data. See main volume, Chapter 14.

c Sampling site was removed; therefore, no samples were collected after March 2000.

d Sampling site power source was damaged in auto accident. Repairs are in process.

e Livermore Valley overall median = 5.92×10^{-3} Bq/m³.

f IQR = Interquartile range

g DCG = Derived Concentration Guide of 3.7×10^3 Bq/m³. Percent calculated on the median concentration.

h This dose is the effective dose equivalent.



Table 5-11. Tritium concentration in air, Livermore site perimeter, 2000

Month	Sampling location ^(a)						
	CAFE	COW	MESQ	MET	POOL	SALV	VIS
	(10 ⁻³ Bq/m ³)						
Jan	38.1 ± 7.88	25.7 ± 8.21	66.2 ± 9.10	45.9 ± 10.1	88.4 ± 10.1	23.0 ± 25.1	38.5 ± 10.3
	51.8 ± 25.8	24.3 ± 23.0	22.4 ± 22.6	48.1 ± 30.5	128 ± 28.8	—(b)	51.8 ± 31.3
Feb	28.6 ± 14.7	34.3 ± 17.6	34.2 ± 18.9	38.5 ± 14.2	78.8 ± 18.8	25.9 ± 17.1	57.7 ± 29.0
	70.3 ± 21.4	51.4 ± 23.8	43.7 ± 19.4	36.5 ± 19.2	110 ± 26.4	47.7 ± 22.4	70.7 ± 22.1
Mar	30.1 ± 11.9	15.9 ± 14.2	15.8 ± 12.5	15.3 ± 12.3	51.8 ± 12.9	18.9 ± 11.8	26.4 ± 12.0
	68.5 ± 13.9	33.6 ± 15.0	34.2 ± 12.9	13.0 ± 12.7	289 ± 22.6	27.3 ± 12.9	28.0 ± 13.0
	129 ± 16.4	59.9 ± 16.7	17.2 ± 12.8	9.14 ± 13.4	206 ± 25.0	19.7 ± 13.5	33.5 ± 14.3
Apr	80.3 ± 13.6	27.4 ± 12.8	13.5 ± 10.4	6.33 ± 10.8	172 ± 22.7	20.1 ± 11.1	29.0 ± 12.0
	25.0 ± 16.6	15.8 ± 15.4	10.2 ± 15.8	11.2 ± 17.4	22.9 ± 20.9	9.10 ± 16.6	29.2 ± 18.6
May	17.8 ± 20.3	45.9 ± 21.8	6.51 ± 19.5	0.870 ± 21.0	38.5 ± 32.1	17.5 ± 20.4	54.8 ± 22.9
	76.6 ± 21.5	—(b)	27.2 ± 20.1	13.5 ± 23.2	155 ± 26.1	41.8 ± 19.9	40.3 ± 19.8
Jun	19.8 ± 17.3	34.1 ± 19.1	9.29 ± 17.9	5.74 ± 17.4	72.2 ± 28.9	8.29 ± 16.1	248 ± 24.7
	75.9 ± 26.0	82.5 ± 24.5	17.7 ± 22.9	17.9 ± 23.9	343 ± 46.3	35.6 ± 21.9	81.0 ± 13.7
Jul	7.22 ± 14.1	51.1 ± 16.2	1.54 ± 14.3	-2.13 ± 13.4	39.6 ± 19.9	16.8 ± 14.2	—(b)
	6.22 ± 19.9	47.4 ± 21.4	0.511 ± 20.2	-5.03 ± 18.1	54.4 ± 27.6	14.5 ± 18.1	79.6 ± 18.5
Aug	40.3 ± 17.7	69.9 ± 15.8	24.4 ± 14.9	11.0 ± 13.6	74.4 ± 19.0	41.1 ± 15.6	99.2 ± 17.9
	38.5 ± 15.2	1370 ± 43.7	22.1 ± 14.4	186 ± 24.3	57.4 ± 16.7	30.1 ± 12.8	79.9 ± 14.8
	13.2 ± 15.1	29.7 ± 16.4	9.88 ± 14.8	—(b)	42.2 ± 18.1	26.9 ± 14.8	61.4 ± 18.4
Sep	67.0 ± 21.9	28.8 ± 20.9	29.1 ± 20.2	28.3 ± 21.1	102 ± 24.5	—(b)	46.3 ± 19.7
	53.3 ± 24.1	23.5 ± 21.8	22.9 ± 23.5	21.1 ± 23.2	142 ± 29.6	55.1 ± 22.4	57.0 ± 23.5
Oct	21.8 ± 23.0	—(b)	-0.176 ± 23.4	24.6 ± 24.8	135 ± 44.8	40.7 ± 22.3	48.5 ± 25.3
	46.3 ± 15.1	28.4 ± 12.9	28.3 ± 15.2	26.5 ± 14.6	67.0 ± 15.3	45.9 ± 14.0	42.6 ± 15.3
Nov	77.0 ± 23.3	—(b)	19.7 ± 20.6	—(b)	69.9 ± 19.8	30.4 ± 18.2	—(b)
	40.3 ± 14.6	5.48 ± 13.1	29.6 ± 16.9	—(b)	62.2 ± 15.5	—(b)	18.6 ± 12.5
Dec	48.5 ± 15.2	41.1 ± 16.6	26.7 ± 14.6	44.4 ± 26.0	89.5 ± 19.2	49.2 ± 16.5	44.4 ± 14.9
	40.7 ± 13.1	30.0 ± 13.9	19.7 ± 11.9	25.1 ± 14.0	63.6 ± 14.6	27.6 ± 12.2	28.5 ± 10.8
Median ^(c)	40.5	33.6	20.9	17.9	76.6	27.3	47.4
IQR ^(d)	42.2	22.7	17.0	22.3	74.7	21.6	31.3
Percent of DCG ^(e)	1.1×10^{-3}	9.1×10^{-4}	5.6×10^{-4}	4.8×10^{-4}	2.1×10^{-3}	7.4×10^{-4}	1.3×10^{-3}
Dose (mSv) ^(f)	8.4×10^{-6}	7.0×10^{-6}	4.3×10^{-6}	3.7×10^{-6}	1.6×10^{-5}	5.7×10^{-6}	9.8×10^{-6}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error), or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14.

a See Figure 5-1, main volume, for sampling locations.

b No data. See main volume, Chapter 14.

c Livermore site overall median = 34.2×10^{-3} Bq/m³.

d IQR = Interquartile range

e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m³. Percent calculated on the median concentration.

f This dose is the effective dose equivalent.

**Table 5-12. Tritium concentration in air at locations near diffuse sources, 2000**

Month	Sampling locations ^(a)			
	B292	B331	B514	B624
	(10 ⁻³ Bq/m ³)			
Jan	137 ± 13.0	1720 ± 36.7	740 ± 24.2	2650 ± 42.6
	122 ± 30.7	1150 ± 53.3	1140 ± 53.3	4260 ± 96.2
Feb	99.5 ± 23.1	585 ± 33.3	1070 ± 41.4	3400 ± 72.9
	87.3 ± 26.0	884 ± 45.5	1420 ± 46.3	5920 ± 117
Mar	61.8 ± 24.3	500 ± 28.3	833 ± 32.7	4330 ± 73.6
	61.1 ± 16.2	662 ± 30.2	847 ± 34.1	4700 ± 79.2
Apr	55.1 ± 16.3	1660 ± 44.8	1150 ± 37.0	3890 ± 65.5
	40.0 ± 13.5	1340 ± 32.8	1850 ± 47.0	3850 ± 67.0
	37.4 ± 21.7	369 ± 28.3	8470 ± 109	3430 ± 70.3
May	14.3 ± 20.4	455 ± 33.7	4440 ± 83.3	1670 ± 53.7
	— ^(b)	1940 ± 57.7	2850 ± 70.3	4440 ± 86.2
Jun	5.62 ± 17.0	836 ± 38.9	2790 ± 65.9	2110 ± 58.5
	38.5 ± 22.5	2100 ± 65.1	2970 ± 74.7	3960 ± 82.9
Jul	20.5 ± 14.6	174 ± 21.1	3540 ± 79.9	1740 ± 54.8
	8.99 ± 18.8	225 ± 28.0	3270 ± 91.4	1840 ± 65.5
Aug	42.6 ± 16.4	932 ± 38.1	4290 ± 87.7	3120 ± 68.8
	63.6 ± 15.5	274 ± 21.4	3160 ± 69.9	2520 ± 57.7
Sep	7.47 ± 14.8	246 ± 22.9	2680 ± 68.8	2040 ± 58.8
	37.4 ± 20.6	223 ± 24.2	1850 ± 56.6	4140 ± 79.2
Oct	61.8 ± 24.7	348 ± 31.0	2520 ± 69.6	5330 ± 85.1
	37.7 ± 24.9	437 ± 40.7	2510 ± 71.4	3260 ± 80.3
	— ^(b)	204 ± 19.3	1230 ± 44.4	3300 ± 69.6
Nov	— ^(b)	202 ± 24.1	1370 ± 48.5	2740 ± 64.4
	101 ± 19.1	110 ± 17.1	707 ± 31.6	762 ± 30.9
Dec	115 ± 21.9	154 ± 22.1	— ^(b)	1010 ± 40.0
	58.5 ± 13.7	116 ± 15.4	1140 ± 39.2	755 ± 28.5
Median ^(c)	55.1	446	1850	3280
IQR ^(d)	38.1	697	1830	2040
Percent of DCG ^(e)	1.5×10^{-3}	1.2×10^{-2}	5.0×10^{-2}	8.9×10^{-2}
Dose (mSv) ^(f)	1.1×10^{-5}	9.3×10^{-5}	3.8×10^{-4}	6.8×10^{-4}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14.

a See main volume, **Figure 5-1**, for sampling locations.

b No data. See main volume, Chapter 14.

c Diffuse source overall median = 1040×10^{-3} Bq/m³.

d IQR = Interquartile range

e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m³. Percent calculated on the median concentration.

f This dose is the effective dose equivalent.

**Table 5-13. Monthly beryllium in air particulate composites, Livermore site perimeter, 2000**

Month	Sampling location ^(a)					
	CAFE	COW	MESQ	MET	SALV	VIS
	(pg/m ³)					
Jan	10.1	5.94	6.79	6.08	6.23	8.70
Feb	5.71	3.22	5.20	2.21	1.60	2.78
Mar	28.2	22.8	38.2	19.9	18.7	20.0
Apr	16.4	13.6	15.6	11.7	12.5	11.6
May	9.33	7.58	8.72	5.72	4.34	4.51
Jun	16.4	16.0	14.3	13.0	11.3	11.7
Jul	25.7	24.0	19.3	20.0	22.3	18.1
Aug	20.6	17.1	13.5	11.8	14.6	12.7
Sep	19.6	13.0	16.3	13.1	16.2	18.8
Oct	18.0	0.452	8.45	6.90	6.69	8.92
Nov	3.74	2.75	3.87	2.38	2.77	4.51
Dec	5.62	4.24	7.03	4.29	2.80	5.19
Median^(b)	16.4	10.3	11.1	9.30	9.00	10.3
IQR^(c)	13.5	12.3	8.81	7.66	11.0	9.03
Percent of ACL^(d)	0.164	0.103	0.111	0.0930	0.0900	0.103

a See main volume, Figure 5-1, for sampling locations.

b Livermore site perimeter overall median is 11.5 pg/m³.

c IQR = Interquartile range

d The monthly Ambient Concentration Limit (ACL) is 10,000 pg/m³ as set by the Bay Area Air Quality Management District (BAAQMD). Percent calculated on the median concentration.



Table 5-14. Monthly median activities for gross alpha and gross beta summarized from weekly data for Site 300 perimeter and off-site locations, 2000

Month	Sampling location ^(a)								
	Site 300 perimeter								Off site
	801E	COHO	ECP	EOBS	GOLF	NPS	WCP	WOBS	
Gross alpha	(10⁻⁶ Bq/m³)								
Jan	57.0	—(b)	77.3	64.4	93.2	54.8	83.3	82.9	—(b)
Feb	36.4	—(b)	41.3	38.1	36.7	11.0	15.5	18.1	—(b)
Mar	38.6	—(b)	28.3	32.3	30.4	30.1	25.9	41.7	—(b)
Apr	44.0	42.8	64.8	67.7	60.6	67.8	51.4	69.8	31.7
May	48.3	38.0	49.5	48.8	45.2	41.6	51.9	44.6	49.5
Jun	66.3	39.9	60.0	50.1	43.2	43.0	35.2	51.8	63.2
Jul	102	85.5	94.6	92.7	108.0	94.4	96.2	88.4	90.6
Aug	114	89.4	117	97.7	104.0	97.0	91.4	127.0	95.2
Sep	128	107	151	117	130	123	126	108	98.0
Oct	110	91.0	118	71.4	73.3	87.2	83.2	105	88.0
Nov	95.0	108	97.3	86.8	86.1	75.0	95.7	86.5	116
Dec	138	170	178	143	168	157	141	164	203
Annual Median^(c)	78.9	85.1	84.5	73.1	85.2	76.3	81.3	83.4	83.8
IQR^(c,d)	64.8	52.5	76.8	59.9	67.8	66.6	70.4	66.7	60.8
Annual Maximum^(c)	284	270	374	225	299	293	236	317	331
Gross beta	(10⁻⁶ Bq/m³)								
Jan	400	—(b)	514	403	574	459	518	466	—(b)
Feb	212	—(b)	283	234	234	198	173	183	—(b)
Mar	331	—(b)	397	312	342	380	324	325	—(b)
Apr	370	345	382	355	397	365	375	363	278
May	347	361	423	328	372	362	376	365	302
Jun	520	364	611	464	512	476	398	459	423
Jul	468	321	464	397	431	398	376	423	389
Aug	533	418	541	455	534	497	486	508	439
Sep	848	813	857	705	874	849	852	884	760
Oct	747	678	796	641	817	618	665	647	682
Nov	1030	1080	1030	867	1270	871	938	877	1300
Dec	1140	1120	1270	943	1210	1100	1050	1080	1350
Annual Median^(c)	512	507	568	451	519	473	470	484	482
IQR^(c,d)	337	428	367	292	369	261	318	300	452
Annual Maximum^(c)	1670	1810	1620	1420	1920	1580	1420	1530	2080

a See main volume, Figure 5-3, for description of sampling locations.

b No sample collected, see main volume, Chapter 14.

c Summary data is determined from 52 weekly samples for the entire year.

d IQR = Interquartile range

Table 5-15. Gamma activity in air particulate samples, Site 300, 2000^(a)

Month	Radiological isotope						
	⁷ Be	¹³⁷ Cs	⁴⁰ K	²² Na	²²⁶ Ra	²²⁸ Ra	²²⁸ Th
	(10 ⁻³ Bq/m ³)	(10 ⁻⁶ Bq/m ³)					
Jan	0.47 ± 0.063	1.1 ± 0.55	6.7 ± 14	-0.072 ± 0.50	-1.1 ± 3.2	0.34 ± 5.1	0.70 ± 2.4
Feb	0.53 ± 0.061	0.36 ± 0.58	-3.0 ± 21	-0.19 ± 0.59	0.84 ± 4.0	-3.3 ± 4.6	0.51 ± 2.6
Mar	0.81 ± 0.089	-0.078 ± 0.65	-11 ± 21	-0.44 ± 0.70	-1.8 ± 2.9	-3.1 ± 4.7	-0.51 ± 2.9
Apr	0.28 ± 0.032	-0.17 ± 0.38	1.7 ± 23	-0.086 ± 0.41	-2.0 ± 3.3	-3.3 ± 4.8	1.1 ± 2.6
May	0.49 ± 0.053	-0.28 ± 0.49	1.7 ± 19	0.30 ± 0.60	-0.21 ± 2.4	0.25 ± 5.2	0.067 ± 2.1
Jun	1.2 ± 0.13	-0.70 ± 0.96	1.3 ± 32	0.29 ± 1.1	-1.8 ± 5.7	-0.12 ± 6.4	-1.1 ± 5.0
Jul	1.48 ± 0.17	0.56 ± 0.83	-10 ± 28	0.78 ± 0.89	-2.1 ± 3.5	-3.6 ± 6.2	-2.9 ± 3.3
Aug	2.1 ± 0.069	—(b)	-14 ± 24	0.27 ± 0.70	-0.92 ± 4.1	-3.9 ± 6.1	0.23 ± 3.5
Sep	1.9 ± 0.048	0.37 ± 0.45	23 ± 24	0.57 ± 0.52	1.4 ± 3.0	1.5 ± 6.2	0.79 ± 3.1
Oct	1.5 ± 0.041	-0.28 ± 0.42	-23 ± 19	0.25 ± 0.45	-3.0 ± 2.0	0.89 ± 7.4	-3.0 ± 3.5
Nov	0.58 ± 0.030	0.37 ± 0.58	5.5 ± 22	0.29 ± 0.61	-1.4 ± 3.1	-1.9 ± 5.2	-0.83 ± 2.6
Dec	1.0 ± 0.041	0.018 ± 0.65	-26 ± 21	-0.91 ± 0.88	-0.14 ± 4.2	-0.014 ± 5.9	-4.8 ± 2.7
Median	0.91	0.018	-0.85	0.26	-1.3	-1.01	-0.22
IQR ^(c)	0.98	0.60	14	0.40	1.7	3.6	2.1
Maximum	2.1	1.1	23	0.78	1.4	1.5	1.1
Percent of DCG ^(d)	6.0 × 10 ⁻⁵	1.2 × 10 ⁻⁷	7.0 × 10 ⁻⁵	7.0 × 10 ⁻⁷	1.3 × 10 ⁻³	4.1 × 10 ⁻³	0.073
DCG ^(e) (Bq/m ³)	1.5 × 10 ³	15	33	37	0.11	0.037	1.5 × 10 ⁻³

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14.

a All Site 300 perimeter samples composited. See main volume, Figure 5-3, for sampling locations.

b No result for ¹³⁷Cs provided by the analytical laboratory.

c IQR = Interquartile range

d Percent of DCG is determined by using the median value unless median value is negative, when negative the maximum value is used.

e DCG = Derived Concentration Guide (DOE Order 5400.5). See main volume, Chapter 13.

**Table 5-16. Plutonium-239+240 activity in air particulate samples, Site 300 composite, 2000^(a)**

Month	Site 300 composite (10^{-9} Bq/m 3)
Jan	1.59 ± 1.63
Feb	1.24 ± 1.24
Mar	9.76 ± 3.25
Apr	18.6 ± 3.79
May	0
Jun	1.43 ± 1.43
Jul	7.50 ± 10.4
Aug	-3.19 ± 7.89
Sep	3.28 ± 9.31
Oct	0
Nov	0
Dec	0
Median	1.34
IQR^(b)	4.34
Maximum	18.6
Percent of DCG^(c)	1.80×10^{-4}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error), or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. Zero values occur when there are no counts detected from the instrument background or the sample. See the main volume, Chapter 14.

a See main volume, **Figure 5-1**, for sampling locations.

b IQR = Interquartile range

c DCG = Derived Concentration Guide of 7.4×10^{-4} Bq/m 3 for plutonium-239+240 activity in air. Percent DGC calculated on the median value.

**Table 5-17. Uranium mass concentration in air particulate samples, Site 300, 2000^(a)**

Location^(a)	Month	Uranium-235^(b) (10^{-7} $\mu\text{g}/\text{m}^3$)	Uranium-238^(c) (10^{-5} $\mu\text{g}/\text{m}^3$)
801E	Jan	8.70 ± 8.84	4.04 ± 1.67
	Feb	6.30 ± 9.68	7.69 ± 1.85
	Mar	16.1 ± 13.7	3.53 ± 2.54
	Apr	0.991 ± 5.42	0.00 ± 1.59
	May	-4.82 ± 4.23	3.30 ± 1.48
	Jun	-11.9 ± 4.35	4.34 ± 1.28
	Jul	1.34 ± 6.10	0.955 ± 2.31
	Aug	5.65 ± 8.01	4.34 ± 2.67
	Sep	-15.3 ± 20.1	17.7 ± 6.95
	Oct	-1.93 ± 10.0	8.63 ± 4.72
	Nov	5.05 ± 10.3	-1.19 ± 4.81
	Dec	1.30 ± 8.70	1.19 ± 4.28
Median		1.32	3.79
IQR^(d)		8.47	4.05
Maximum		16.1	17.7
Percent of DCG^(e)		2.81×10^{-4}	1.26×10^{-2}
COHO	Jan	— ^(f)	— ^(f)
	Feb	— ^(f)	— ^(f)
	Mar	— ^(f)	— ^(f)
	Apr	0.773 ± 4.95	5.79 ± 1.56
	May	1.39 ± 3.79	-5.38 ± 1.08
	Jun	-3.26 ± 3.95	5.79 ± 1.11
	Jul	8.30 ± 6.53	0.952 ± 2.27
	Aug	-2.75 ± 7.18	5.67 ± 2.68
	Sep	-13.6 ± 20.1	4.18 ± 5.82
	Oct	-6.38 ± 11.7	-4.19 ± 4.09
	Nov	7.78 ± 12.8	-1.64 ± 5.05
	Dec	4.27 ± 8.94	-2.25 ± 4.01
Median		0.773	0. 952
IQR^(d)		7.53	7.92
Maximum		8.30	5.79
Percent of DCG^(e)		1.64×10^{-4}	3.17×10^{-3}

**Table 5-17. Uranium mass concentration in air particulate samples, Site 300, 2000^(a) (continued)**

Location^(a)	Month	Uranium-235^(b) (10^{-7} $\mu\text{g}/\text{m}^3$)	Uranium-238^(c) (10^{-5} $\mu\text{g}/\text{m}^3$)
ECP	Jan	-3.66 ± 8.10	4.46 ± 1.65
	Feb	13.6 ± 10.8	-0.460 ± 1.81
	Mar	4.28 ± 6.76	3.12 ± 1.56
	Apr	7.87 ± 10.14	1.55 ± 1.71
	May	4.41 ± 4.10	2.42 ± 1.23
	Jun	-4.42 ± 4.72	5.38 ± 1.30
	Jul	1.76 ± 6.01	0.595 ± 2.23
	Aug	-0.514 ± 7.32	3.00 ± 2.58
	Sep	-22.3 ± 18.5	5.01 ± 5.52
	Oct	6.54 ± 11.0	13.5 ± 5.11
	Nov	1.48 ± 9.95	-2.53 ± 4.69
	Dec	3.63 ± 9.63	3.59 ± 4.48
Median		2.70	3.06
IQR^(d)		6.24	3.55
Maximum		13.6	13.5
Percent of DCG^(e)		5.73×10^{-4}	1.02×10^{-2}
EOBS	Jan	1.48 ± 8.75	27.4 ± 2.39
	Feb	0.713 ± 7.55	-0.152 ± 1.46
	Mar	12.6 ± 6.53	1.79 ± 1.40
	Apr	33.0 ± 6.02	44.6 ± 1.91
	May	1.64 ± 3.69	2.38 ± 0.825
	Jun	-4.63 ± 4.77	3.71 ± 1.29
	Jul	1.35 ± 6.03	1.42 ± 2.31
	Aug	3.97 ± 7.69	3.71 ± 2.59
	Sep	-24.6 ± 18.7	4.28 ± 5.61
	Oct	-4.77 ± 11.8	7.44 ± 4.55
	Nov	1.04 ± 10.1	-2.66 ± 4.66
	Dec	1.69 ± 9.07	4.46 ± 4.57
Median		1.42	3.71
IQR^(d)		2.88	3.51
Maximum		33.0	44.6
Percent of DCG^(e)		3.01×10^{-4}	1.24×10^{-2}

**Table 5-17. Uranium mass concentration in air particulate samples, Site 300, 2000^(a) (continued)**

Location^(a)	Month	Uranium-235^(b) (10^{-7} $\mu\text{g}/\text{m}^3$)	Uranium-238^(c) (10^{-5} $\mu\text{g}/\text{m}^3$)
GOLF	Jan	6.67 ± 8.15	5.46 ± 1.58
	Feb	-0.238 ± 8.06	0.00 ± 1.57
	Mar	25.0 ± 8.10	35.0 ± 2.36
	Apr	5.51 ± 5.05	0.962 ± 1.47
	May	3.00 ± 3.78	1.95 ± 1.16
	Jun	-8.20 ± 4.60	4.22 ± 1.31
	Jul	1.38 ± 6.02	2.40 ± 2.34
	Aug	1.95 ± 7.59	4.69 ± 2.65
	Sep	-16.7 ± 20.4	7.84 ± 4.51
	Oct	-4.09 ± 10.9	6.03 ± 4.60
	Nov	-7.96 ± 10.8	-1.35 ± 4.93
	Dec	6.81 ± 10.8	3.74 ± 4.66
Median		1.67	3.98
IQR^(d)		10.9	3.90
Maximum		25.0	35.0
Percent of DCG^(e)		3.54×10^{-4}	1.33×10^{-2}
NPS	Jan	0.00 ± 10.9	0.832 ± 2.03
	Feb	-1.59 ± 8.33	-0.508 ± 1.63
	Mar	21.8 ± 8.47	1.48 ± 1.58
	Apr	4.68 ± 4.91	2.13 ± 1.46
	May	4.38 ± 3.95	4.16 ± 1.21
	Jun	-2.54 ± 4.77	2.67 ± 1.27
	Jul	1.99 ± 5.98	1.32 ± 2.27
	Aug	0.972 ± 7.32	4.75 ± 2.60
	Sep	-1.48 ± 24.3	2.96 ± 6.55
	Oct	-1.09 ± 11.1	5.64 ± 4.85
	Nov	-0.921 ± 10.4	0.740 ± 5.05
	Dec	10.8 ± 10.1	2.22 ± 4.34
Median		0.486	2.18
IQR^(d)		5.64	2.06
Maximum		21.8	5.64
Percent of DCG^(e)		1.03×10^{-4}	7.25×10^{-3}

**Table 5-17. Uranium mass concentration in air particulate samples, Site 300, 2000^(a) (continued)**

Location^(a)	Month	Uranium-235^(b) (10^{-7} $\mu\text{g}/\text{m}^3$)	Uranium-238^(c) (10^{-5} $\mu\text{g}/\text{m}^3$)
TFIR	Jan	—(f)	—(f)
	Feb	—(f)	—(f)
	Mar	—(f)	—(f)
	Apr	8.75 ± 4.44	8.52 ± 1.32
	May	8.47 ± 4.04	7.48 ± 1.22
	Jun	2.29 ± 4.91	7.48 ± 1.31
	Jul	0.799 ± 7.65	2.45 ± 3.02
	Aug	6.67 ± 7.73	15.3 ± 2.89
	Sep	0.184 ± 28.6	9.23 ± 7.81
	Oct	5.86 ± 11.1	10.0 ± 4.86
	Nov	2.07 ± 10.4	5.08 ± 5.35
	Dec	4.82 ± 9.31	0.297 ± 4.25
Median		4.82	7.48
IQR^(d)		4.60	4.15
Maximum		8.75	15.3
Percent of DCG^(e)		1.03×10^{-3}	2.49×10^{-2}
WCP	Jan	-0.556 ± 7.85	2.74 ± 1.56
	Feb	1.57 ± 7.50	-1.59 ± 1.39
	Mar	5.42 ± 6.81	1.29 ± 1.54
	Apr	-1.52 ± 4.72	1.33 ± 1.45
	May	1.86 ± 3.69	3.18 ± 1.17
	Jun	-10.9 ± 4.68	3.77 ± 1.37
	Jul	-1.65 ± 5.81	-2.04 ± 2.23
	Aug	-1.01 ± 7.45	5.73 ± 2.76
	Sep	-13.4 ± 25.0	5.68 ± 7.51
	Oct	-4.01 ± 9.85	5.66 ± 4.48
	Nov	1.10 ± 10.7	-2.21 ± 4.78
	Dec	2.02 ± 9.49	5.46 ± 4.72
Median		-0.78	2.96
IQR^(d)		3.88	4.94
Maximum		5.42	5.73
Percent of DCG^(e)		1.15×10^{-3}	9.87×10^{-3}

**Table 5-17. Uranium mass concentration in air particulate samples, Site 300, 2000^(a) (concluded)**

Location^(a)	Month	Uranium-235^(b) (10^{-7} $\mu\text{g}/\text{m}^3$)	Uranium-238^(c) (10^{-5} $\mu\text{g}/\text{m}^3$)
WOBS	Jan	11.7 \pm 9.12	32.4 \pm 2.36
	Feb	-3.27 \pm 6.67	-1.68 \pm 1.30
	Mar	8.10 \pm 52.3	3.21 \pm 1.52
	Apr	-2.98 \pm 4.72	0.239 \pm 1.48
	May	0.838 \pm 3.57	1.79 \pm 1.13
	Jun	-8.57 \pm 4.91	5.23 \pm 1.43
	Jul	2.50 \pm 6.38	-1.43 \pm 2.30
	Aug	0.699 \pm 7.36	4.78 \pm 2.62
	Sep	-19.7 \pm 18.9	3.35 \pm 5.51
	Oct	2.34 \pm 10.5	1.79 \pm 4.16
	Nov	4.01 \pm 13.5	-0.296 \pm 5.44
	Dec	5.37 \pm 10.1	1.78 \pm 4.40
Median		1.59	1.79
IQR^(d)		7.40	3.60
Maximum		11.7	32.4
Percent of DCG^(e)		3.38×10^{-4}	5.97×10^{-3}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. Negative values occur when the instrument or filter background is greater than sample activity. See the main volume, Chapter 14.

a See main volume, Figure 5-3, for sampling locations.

b Uranium-235 activities in Bq/m^3 can be determined by dividing the weight in $\mu\text{g}/\text{m}^3$ by 12.5.

c Uranium-238 activities in Bq/m^3 can be determined by dividing the weight in $\mu\text{g}/\text{m}^3$ by 80.3.

d IQR = Interquartile range

e DCG = Derived Concentration Guide for activity in air of $0.3 \mu\text{g}/\text{m}^3$ for uranium-238 and $0.047 \mu\text{g}/\text{m}^3$ for uranium-235. Percent DCG calculated on the median value.

f No sample collected, see main volume, Table 14-1, for reason.

**Table 5-18. Tritium concentration in air, Site 300, 2000**

Month	Sampling location ^(a)
	COHO
	(10^{-3} Bq/m 3)
Jan ^(b)	3.89 ± 6.51
Feb ^(b)	7.62 ± 23.7 ^(c)
Mar ^(b)	-13.0 ± 18.8 7.25 ± 11.5 -1.10 ± 9.88 -4.29 ± 12.1
Apr	7.44 ± 15.5 -16.7 ± 13.2
May	-9.29 ± 16.8 -3.74 ± 14.5
Jun	4.40 ± 11.4 -3.96 ± 8.99
Jul	1.48 ± 10.1 -3.06 ± 15.8
Aug	1.45 ± 11.0 1.62 ± 11.2 4.63 ± 12.8
Sep	-19.6 ± 17.4 -5.77 ± 21.4
Oct	-9.36 ± 22.6 5.99 ± 13.4
Nov	-2.27 ± 17.1 -8.81 ± 11.2
Dec	-5.88 ± 14.1 7.88 ± 10.7
Median	-2.27
IQR ^(d)	10.3
Percent of DCG ^(e)	2.1×10^{-4}
Dose (mSv) ^(f)	1.6×10^{-6}

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14.

- a See main volume, **Figure 5-3**, for sampling locations.
- b The January samples are from location PRIM which was removed from service on January 26, 2000. The February sample and first two samples in March are from B850. The B850 location was used so that continuous monitoring could occur at Site 300. Results from this location are considered a conservative estimate of tritium concentrations near the perimeter of Site 300.
- c No data; see main volume, Chapter 14.
- d IQR = Interquartile range
- e DCG = Derived Concentration Guide of 3.7×10^3 Bq/m 3 . Percent calculated from the maximum concentration because the median value was negative.
- f This dose is the effective dose equivalent. Dose was determined by using the maximum value because the median value was negative.



Table 5-19. Beryllium in air particulate samples, Site 300 network, 2000

Month	Sampling location ^(a)			
	801E	EOBS	GOLF	TFIR
Jan	3.92	2.84	6.30	— ^(b)
Feb	2.15	1.17	3.21	— ^(b)
Mar	8.38	4.95	16.6	— ^(b)
Apr	16.3	8.42	10.2	15.9
May	5.48	4.68	4.93	14.8
Jun	12.1	11.5	12.0	20.6
Jul	25.7	11.7	17.6	25.6
Aug	11.5	9.58	12.0	23.2
Sep	15.1	10.8	16.1	30.4
Oct	6.54	1.60	7.84	6.49
Nov	2.18	1.09	0.00 ^(c)	3.79
Dec	4.04	3.69	4.28	5.26
Median ^(d)	7.46	4.82	10.2	15.9
IQR ^(e)	8.84	7.36	8.44	16.7
Percent of ACL ^(f)	0.0746	0.0482	0.102	0.159

a See main volume, **Figure 5-3**, for sampling locations.

b No sample collected due to lack of power at sampling location.

c Actual reported value provided by analytical laboratory.

d Median value for all Site 300 locations is 8.4 pg/m³.

e IQR = Interquartile range

f The monthly Ambient Concentration Limit (ACL) is 10,000 pg/m³ as set by the Bay Area Air Quality Management District (BAAQMD). Percent calculated on the median concentration.

SEWERABLE WATER MONITORING

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Discharges of Treated Groundwater

Discharges of groundwater to Lawrence Livermore National Laboratory's sanitary sewer must comply with the terms and conditions in Permit 1510G(99), issued by the Livermore Water Reclamation Plant (LWRP). Table 6-1 shows discharge dates and monitoring data for discharges of groundwater. The self-monitoring program prescribed in this groundwater discharge permit requires compliance with the parameters specified in **Table 6-2** in the main volume.

Flow Monitoring Methods

To monitor effluent flow, LLNL used a flow chart recorder installed inside the LLNL Sewer Monitoring Station (SMS) and an ultrasonic flow sensor in the adjacent underground sewer vault (see main volume, **Figure 6-1**). Every day a flow totalizer reading was recorded on the flow chart recorder when the daily composite sample was acquired from the SMS. Daily total flows were calculated by subtracting sequentially recorded flow totalizer readings and were estimated when flow totalizer readings were not available.

Table 6-2a shows the daily total flows.

Table 6-2b presents monthly and annual flow summary statistics for 2000.

Sewage Sampling Methods and Analytical Procedures

LLNL operated a flow-proportional, peristaltic-pump composite sampler in the SMS. This sampler created a 24-hour composite of the Livermore site sewage effluent by taking a sample every 3785 L of effluent. Every day, technologists transferred 500-mL aliquots of this 24-hour composite to polyethylene bottles and submitted them for analysis.

Two aliquots were submitted to LLNL's Hazards Control Analytical Laboratory (HCAL) for daily analyses of the gross alpha, gross beta, and tritium activity. For the gross alpha and gross beta analyses, HCAL digested a 150-mL aliquot, plated the digestate onto a planchette, and submitted the planchette to the Hazards Control Radiological Measurements Laboratory (HCRML) for a 100-min count in a gas-proportional counter. For the tritium analyses, HCAL distilled a 100-mL aliquot and submitted the distillate to HCRML. HCRML prepared 5 mL of the distillate with a scintillation cocktail and counted it for 100 min in a liquid scintillation counter. The analytical results for the gross alpha, gross beta, and tritium analyses are shown in Table 6-3.

A third daily aliquot was submitted to LLNL's Chemistry and Materials Science Environmental Services (CES). From the aliquots submitted for



each month, CES created a composite sample and analyzed it, first for ^{239}Pu , and then for ^{137}Cs .

The ^{239}Pu was analyzed by adding approximately 15 L of MnO_2 to the entire volume of the monthly composite sample to precipitate the plutonium. After the composite volume was digested with concentrated HNO_3 , CES used ion-exchange chromatography to separate the plutonium from the rest of the sample. The plutonium eluted from the ion-exchange column was electroplated onto a stainless steel disk, and its activity was measured by alpha spectroscopy.

Before beginning analysis for ^{137}Cs activity in the monthly composite, CES returned any nonplutonium sample material generated from the ion-exchange process to the monthly composite sample in order to prevent ^{137}Cs loss. For the ^{137}Cs analysis, CES added NH_4MoPO_4 to the monthly composite sample in order to precipitate the cesium and then counted the composite sample using gamma spectroscopy. The analytical results for the ^{239}Pu and ^{137}Cs analyses are reported in the main volume, **Table 6-5**.

In 2000, LWRP provided two types of sample—treated effluent and sludge—to LLNL for analysis. LWRP collected two 500-mL aliquots of treated effluent daily and used them to create two different composite samples: (1) a week of daily aliquots, and (2) a month of daily aliquots. LLNL technologists transferred the weekly sample (composited in a 1-gal polyethylene bottle) to HCAL for gross alpha, gross beta, and tritium analyses. Table 6-4 shows the tritium results for the LWRP weekly composite sample.

CES analyzed the LWRP monthly sample, which is composited in a 5-gal polyethylene carboy, for ^{137}Cs using gamma spectroscopy and for ^{239}Pu using alpha spectroscopy. The results of the

analysis are presented in **Table 6-5** of the main volume.

The other type of sample was sludge from the LWRP digesters. Each month, LWRP employees provided two 500-mL composite samples from each of the digesters. The composites consisted of aliquots taken from the circulating sludge once a week. LLNL collected the composite samples and submitted one 500-mL composite to HCAL and a second 500-mL composite to CES. HCAL analyzed the monthly composite for gross radioactivity and metals. CES composited all of the monthly samples on a quarterly basis and analyzed the quarterly composites for plutonium, cesium, and gamma-emitting radionuclides, using alpha spectroscopy for the plutonium and gamma spectroscopy for the cesium and gamma-emitting radionuclides. **Table 6-5** in the main volume shows the results for the ^{239}Pu analyses.

Throughout Chapter 6, gross alpha, gross beta, and tritium are displayed in bequerels per unit volume, and the activities shown in Tables 6-3 and 6-4 are the measured concentrations and their associated $\pm 2\sigma$ counting errors. A $\pm 2\sigma$ error is not shown when the measured concentration is below the limit of sensitivity (LOS). The LOS is determined individually for each sample analysis according to the following equation:

$$\text{LOS} = \frac{C}{Et}$$

where

C = Minimum significant count, above background radiation, for a length of time (t)

E = System counting efficiency

t = Sample counting time

LLNL also operated monitoring station C196 with a flow-proportional, peristaltic pump composite sampler adjacent to the SMS. This sampler functioned as a weekly composite sampler and acquired a 60-mL sample for every 30,280 L of effluent LLNL discharged during a seven-day period. Another sampler operated once a month for 24 hours as a single-day composite sampler and collected a 65-mL sample for every 7570 L of effluent discharged.

Aliquots were acquired each week from the weekly composite sample and every month from the 24-hour composite sample. From each weekly composite (and each monthly 24-hour composite), analysts transferred one 1-L aliquot to a polyethylene bottle. This aliquot was submitted to an off-site contract laboratory for analyses of aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, and zinc. The results for these analyses are presented in Tables 6-5 and 6-6; the EPA methods used for these analyses are identified by the method numbers 200.7, SM-3114B, 210.2, 200.7, 200.7, 200.7, 200.7, 239.2, 245.2, 249.2, 200.7, and 200.7, respectively. See the main volume, **Table 6-2**, for constituent analyses required by the LWRP permit.

Two additional aliquots from the weekly composite were submitted each week to HCAL for analyses of gross alpha, gross beta, and tritium. A subset of these results contributes to the completeness of the daily analytical results for gross alpha, gross beta, and tritium; this subset is reported and footnoted in Table 6-3.

Aliquots were submitted to the contract analytical laboratory for more extensive analyses on the 24-hour composite than on the weekly composite sample. Under the heading of "Composite sample," Table 6-7 lists these results by

parameters, the EPA method numbers used for the analyses, and month. (The analytical methods are EPA methods unless otherwise indicated.) It should be noted that only Table 6-6 reports the monthly metals analytical results for those metals mentioned previously.

Concurrent with the monthly acquisition of a 24-hour composite, a portable, peristaltic-pump sampler collected instantaneous grab samples from the sewage stream in the sewer vault adjacent to SMS. These samples were submitted to a contract analytical laboratory for additional monitoring of water quality parameters and organic compounds. The results of this monitoring are presented in Table 6-7 under the "Grab sample" heading. The table lists the parameters and the EPA method numbers used for the analyses. Samples for oil and grease (as well as cyanide) are collected semiannually rather than monthly. The entries for oil and grease show the results for samples that were acquired at intervals during the day as well as the time of collection of each oil and grease sample.

Quality Assurance Methods

Standard quality control and quality assurance procedures were followed in the collection of LLNL samples. When each sewage field sample was collected, it was labeled with the sampling location and date of sampling. In the laboratory, each sample was assigned a number that accompanied that sample during analysis. Additionally, split samples accounted for approximately 10% of the samples submitted for analytical work in 2000.



Table 6-1. Laboratory analytical results for groundwater discharges to the sanitary sewer, January 1 through December 31, 2000

Sample dates	Discharge dates	pH ^(a)	Total toxic organics, mg/L ^(b)
Discharge criteria		5 to 10	<1.00
5/26	9/27	7	0.0058 ^(c)
11/13	11/13	8.6	0.00052 ^(d)
12/07	12/07	8.5	0.0014 ^(e)

a pH was verified prior to discharge. The pH at final discharge may be slightly different but was always between 5 and 10.

b Total toxic organics (TTO) is the sum of concentrations of compounds detected by EPA Method 601 or approved alternate method for wastewater.

c 0.0058 mg/L = 0.0018 mg/L of chloroform + 0.0040 mg/L of trichloroethene

d 1,2-Dichloroethane

e Chloroform

Table 6-2a. Daily flow totals for Livermore site sanitary sewer effluent (ML), 2000

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.577	1.091	1.210	1.197	0.682	0.832	1.145	1.016	1.070	0.458	1.043	1.487
2	0.523	1.057	1.182	0.560	1.220	1.232	0.690	1.064	1.046	0.503	0.987	1.177
3	0.606	1.882	1.227	0.622	1.272	0.887	0.754	1.198	0.416	1.072	0.989	0.397
4	1.235	1.293	1.086	1.273	1.248	0.406	0.680	1.250	0.408	1.719	0.960	0.405
5	1.218	1.055	0.548	1.346	1.418	0.460	0.394	1.020	0.524	1.526	0.585	0.994
6	1.255	0.436	0.498	1.254	1.881	1.040	1.074	0.426	1.035	1.199	0.565	1.013
7	1.383	0.435	1.277	1.339	2.223	1.052	1.379	0.506	1.151	0.969	1.262	1.046
8	1.250	1.277	1.205	1.173	1.138	1.075	0.958	1.146	1.321	0.481	1.025	0.913
9	0.588	1.325	1.197	0.600	1.442	1.120	0.319	1.011	1.118	0.535	1.061	0.886
10	0.708	1.157	1.182	0.696	1.272	0.928	0.396	1.260	0.661	1.043	1.030	0.380
11	1.191	1.287	1.068	1.252	1.434	0.429	1.075	1.408	0.864	1.116	1.004	0.400
12	1.242	1.291	0.488	1.244	1.483	0.370	1.112	0.987	1.030	1.163	0.557	1.065
13	1.125	0.580	0.587	1.342	1.239	1.087	1.088	0.425	1.165	1.029	0.605	1.043
14	1.187	0.934	1.213	1.407	0.544	1.036	1.179	0.570	1.066	0.995	1.069	0.998
15	1.030	1.280	1.191	1.199	0.545	1.036	0.916	0.984	1.142	0.464	0.989	0.956
16	0.531	1.230	1.275	0.745	1.075	1.087	0.330	0.914	1.397	0.543	0.929	0.907
17	0.549	1.262	1.242	0.710	1.165	1.025	0.390	1.000	1.005	1.043	1.018	0.394
18	0.770	1.151	1.048	1.661	1.204	0.746	0.877	1.347	0.982	1.159	0.924	0.360
19	1.175	1.159	0.503	1.253	1.448	0.764	1.100	0.956	1.067	1.072	0.421	1.001
20	1.281	0.701	0.504	1.555	1.128	1.162	1.177	0.414	0.923	1.226	0.457	0.977
21	1.231	0.844	1.652	1.294	0.604	1.142	1.092	0.369	1.078	0.970	1.052	1.043
22	1.248	1.004	1.679	1.147	0.820	1.140	1.000	1.084	1.132	0.526	0.905	0.922
23	0.366	1.499	1.779	0.750	1.192	1.577	0.434	1.034	0.975	0.503	0.852	0.723
24	0.957	1.331	1.313	0.815	1.183	1.018	0.495	1.017	0.607	1.049	0.372	0.396
25	1.538	1.208	1.070	1.967	1.216	0.390	1.024	1.245	0.706	0.971	0.400	0.335
26	1.278	1.105	0.579	1.307	1.311	0.469	1.224	0.837	1.101	1.061	0.393	0.360
27	1.265	0.603	0.594	1.287	1.108	1.035	1.276	0.381	1.004	1.254	0.422	0.362
28	1.304	0.610	1.162	1.287	0.593	0.921	1.059	0.510	1.164	0.982	1.054	0.791
29	1.095	1.696	1.276	1.196	0.634	1.037	0.937	1.113	1.186	0.568	1.089	0.607
30	0.443		1.334	0.659	0.825	1.415	0.329	1.079	0.922	0.539	1.054	0.583
31	0.527		1.312		1.127		0.405	1.107		1.056		0.359

Note: Shaded volumes indicate an estimation of the daily flow total; actual volumes are not available. Weekend and holiday daily flow totals are shown in the boxed areas. Note that the majority of the flow volume recorded for a given day was actually discharged on the previous day.



Table 6-2b. Monthly and annual flow summary statistics for Livermore site sanitary sewer effluent (ML), 2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2000
Weekend days and holidays													
Total	7.145	6.147	4.301	8.124	8.608	4.034	4.936	3.601	6.173	5.120	4.777	4.148	67.114
Daily Minimum	0.366	0.435	0.488	0.560	0.544	0.370	0.319	0.369	0.408	0.458	0.372	0.335	0.319
Daily Maximum	0.957	1.004	0.594	1.967	2.223	0.764	0.754	0.570	1.005	0.568	0.605	0.405	2.223
Daily Mean	0.595	0.683	0.538	0.812	0.861	0.504	0.449	0.450	0.686	0.515	0.478	0.377	0.579
Weekdays													
Total	23.531	25.636	29.180	26.013	27.066	23.884	21.372	25.077	23.093	23.674	20.296	19.132	287.954
Daily Minimum	1.030	1.055	1.048	1.147	1.075	0.832	0.680	0.837	0.922	0.969	0.852	0.583	0.583
Daily Maximum	1.538	1.882	1.779	1.661	1.881	1.577	1.379	1.408	1.397	1.719	1.262	1.487	1.882
Daily Mean	1.238	1.282	1.269	1.301	1.289	1.086	1.082	1.090	1.100	1.127	1.015	0.957	1.152
All days													
Total	30.676	31.783	33.481	34.137	35.674	27.918	26.308	28.678	29.266	28.794	25.073	23.280	355.068
Daily Minimum	0.366	0.435	0.488	0.560	0.544	0.370	0.319	0.369	0.408	0.458	0.372	0.335	0.319
Daily Maximum	1.538	1.882	1.779	1.967	2.223	1.577	1.379	1.408	1.397	1.719	1.262	1.487	2.223
Daily Mean	0.990	1.096	1.080	1.138	1.151	0.931	0.849	0.925	1.041	0.929	0.836	0.751	0.970

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
January	1	19.1	61.1	0.171 ± 0.072	0.100	7.81
	2	36.6	59.2	0.144 ± 0.069	0.0992	1.44
	3	10.4	61.4	0.174 ± 0.071	0.101	-1.99
	4	28.3	78.8	0.670 ± 0.100	0.106	-1.46
	5	99.2 ± 47.6	81.0	0.648 ± 0.097	0.107	-1.75
	6	275 ± 80	85.5	0.918 ± 0.110	0.107	2.85
	7	243 ± 78	91.4	0.999 ± 0.110	0.108	3.17
	8	120 ± 53	99.5	1.08 ± 0.12	0.111	-5.11
	9	110 ± 51	67.0	0.354 ± 0.081	0.103	5.03
	10	76.2	77.0	0.303 ± 0.082	0.105	4.00
	11	-24.2	67.7	1.11 ± 0.17	0.176	2.71
	12	102 ± 52	96.9	0.751 ± 0.105	0.110	2.63
	13	45.9	107	0.655 ± 0.105	0.114	-0.981
	14	7.73	116	0.781 ± 0.109	0.116	2.26
	15	-19.1	98.4	0.910 ± 0.109	0.111	0.648
	16	-52.2	93.2	0.353 ± 0.088	0.109	-0.847
	17	5.92	87.0	0.263 ± 0.081	0.108	4.63
	18	-19.2	81.0	0.291 ± 0.082	0.107	2.07
	19	32.4	102	0.799 ± 0.112	0.112	-2.93
	20	56.2	94.7	0.659 ± 0.099	0.110	3.35
	21	16.5	107	0.777 ± 0.109	0.114	4.18
	22	23.2	99.9	0.895 ± 0.116	0.111	5.44
	23	208 ± 75	91.4	0.525 ± 0.095	0.109	1.12
	24	18.4	85.5	0.329 ± 0.085	0.108	7.44
	25	79.2	115	0.895 ± 0.116	0.116	2.11
	26	-11.6	88.8	0.673 ± 0.101	0.108	76.6 ± 8.4
	27	614 ± 120	93.2	0.914 ± 0.119	0.130	8.51
	28	65.9	96.9	0.744 ± 0.119	0.131	21.3 ± 7.0
	29	64.4	85.8	0.725 ± 0.116	0.128	15.1 ± 6.5
	30	85.5 ± 49.6	69.6	0.125 ± 0.081	0.123	-3.74
	31	44.4	65.1	0.0077	0.121	3.77
February	1	4.63	86.6	0.862 ± 0.121	0.128	0.929
	2	78.1	91.4	0.710 ± 0.114	0.129	4.44
	3	15.5	94.4	0.844 ± 0.110	0.109	4.70
	4	18.9	85.1	0.722 ± 0.101	0.107	37.4 ± 7.5

**Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)**

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
February	5 -9.81	81.0	1.05 \pm 0.12	0.106	16.8 \pm 6.9	11.1
	6 -20.7	73.3	0.270 \pm 0.081	0.104	21.3 \pm 6.8	10.9
	7 -24.1	72.5	0.196 \pm 0.077	0.104	13.2 \pm 6.3	10.5
	8 2.94	83.6	0.644 \pm 0.097	0.106	39.6 \pm 7.1	10.9
	9 -37.4	83.3	0.810 \pm 0.105	0.106	14.4 \pm 6.6	10.9
	10 -16.3	84.0	0.633 \pm 0.108	0.128	24.7 \pm 7.2	11.3
	11 229 \pm 78	105	1.08 \pm 0.13	0.134	99.5 \pm 8.5	10.8
	12 81.4	93.2	1.04 \pm 0.13	0.130	-1.21	11.0
	13 -2.25	82.1	0.151 \pm 0.087	0.127	4.59	10.8
	14 45.1	72.9	0.0796	0.125	11.5 \pm 6.5	10.8
	15 206 \pm 87	134	1.20 \pm 0.18	0.194	5.96	11.0
	16 -8.21	96.6	0.947 \pm 0.114	0.110	3.61	10.8
	17 26.3	104	0.744 \pm 0.104	0.112	-4.14	11.5
	18 0.522	90.7	0.836 \pm 0.109	0.108	1.68	11.2
	19 19.9	95.1	0.773 \pm 0.108	0.109	-2.29	11.2
	20 33.8	76.2	0.264 \pm 0.079	0.105	4.74	10.8
	21 6.07	75.9	0.202 \pm 0.077	0.105	1.83	10.7
	22 -28.1	76.2	0.381 \pm 0.084	0.105	2.38	11.1
	23 -0.759	87.7	0.925 \pm 0.111	0.107	-4.14	11.4
	24 55.5	96.2	0.881 \pm 0.106	0.109	91.4 \pm 7.3	8.81
	25 3.96	95.1	1.01 \pm 0.11	0.109	33.4 \pm 6.0	9.07
	26 -6.51	88.4	0.799 \pm 0.104	0.107	4.44	8.92
	27 -7.99	71.8	0.344 \pm 0.083	0.104	8.03	8.29
	28 -5.03	75.5	0.218 \pm 0.076	0.104	4.18	8.81
	29 -39.6	79.2	0.629 \pm 0.094	0.105	3.77	11.1
March	1 112 \pm 53	94.7	0.821 \pm 0.107	0.108	90.7 \pm 8.4	11.2
	2 122 \pm 49	80.3	0.969 \pm 0.107	0.105	6.85	10.7
	3 102 \pm 55	92.5	0.699 \pm 0.105	0.109	4.14	10.5
	4 2.75	83.3	0.951 \pm 0.114	0.107	-0.351	10.8
	5 30.0	71.0	0.200 \pm 0.076	0.104	0.326	10.9
	6 -25.2	69.2	0.218 \pm 0.076	0.104	7.25	10.6
	7 21.9	104	0.814 \pm 0.106	0.112	4.18	10.7
	8 57.0	79.6	0.862 \pm 0.103	0.106	-1.08	11.0
	9 3.04	87.0	0.784 \pm 0.102	0.107	0.360	10.8

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)		
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)	
March	10	30.4	85.8	0.825 ± 0.107	0.107	-2.36	11.1
	11	-26.6	92.9	0.751 ± 0.105	0.109	5.07	10.7
	12	54.0	77.7	0.364 ± 0.084	0.105	-0.154	11.0
	13	-6.03	81.4	0.174 ± 0.076	0.106	-3.21	10.7
	14	4.40	88.8	0.577 ± 0.098	0.108	4.14	10.7
	15	7.73	82.5	0.792 ± 0.103	0.106	1.04	11.1
	16	20.8	85.1	0.636 ± 0.095	0.107	1.89	11.1
	17	13.2	92.9	0.862 ± 0.112	0.109	7.36	10.3
	18	6.29	79.2	0.659 ± 0.099	0.106	-4.51	11.1
	19	24.3	72.5	0.172 ± 0.074	0.104	-0.138	10.7
	20	21.9	67.7	0.184 ± 0.074	0.103	10.1	10.4
	21	36.7	86.2	0.673 ± 0.101	0.107	-1.43	10.9
	22	-34.3	73.3	0.463 ± 0.088	0.104	1.22	10.7
	23	37.7	79.2	0.537 ± 0.091	0.106	0.233	11.2
	24	-0.648	79.6	0.740 ± 0.104	0.106	7.03	11.0
	25	-5.33	81.0	0.722 ± 0.101	0.106	1.12	11.1
	26	-20.4	71.0	0.302 ± 0.082	0.104	-1.10	11.0
	27	-28.9	67.0	0.199 ± 0.076	0.103	-2.59	11.0
	28	-29.2	86.2	0.607 ± 0.097	0.107	-0.47	11.0
	29	-1.75	91.0	0.662 ± 0.099	0.108	0.161	10.8
	30	31.4	109	0.792 ± 0.119	0.134	-5.40	11.2
	31	64.8	89.5	0.540 ± 0.103	0.128	3.96	10.8
April	1	-25.7	93.2	0.607 ± 0.109	0.129	-1.58	11.0
	2	17.5	90.3	0.137 ± 0.086	0.128	-4.00	10.9
	3	48.5	95.8	0.114	0.129	1.21	10.9
	4	18.4	108	0.614 ± 0.111	0.133	5.99	10.9
	5	12.0	92.1	0.488 ± 0.103	0.128	1.35	10.9
	6	36.7	91.0	0.574 ± 0.109	0.128	3.92	10.8
	7	87.3	97.3	0.814 ± 0.106	0.109	9.36	11.1
	8	-52.2	87.3	0.814 ± 0.106	0.106	2.65	8.77
	9	31.3	85.8	0.159 ± 0.075	0.106	0.71	8.77
	10	21.2	85.1	0.199 ± 0.077	0.106	4.88	8.66
	11	42.9	107	1.03 ± 0.11	0.112	-0.692	8.99
	12	18.1	87.3	0.725 ± 0.102	0.106	-1.25	10.8
	13	4.44	88.1	0.503 ± 0.091	0.107	-2.74	11.1

**Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)**

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
April	14 50.7	94.0	0.714 \pm 0.100	0.108	3.96	10.8
	15 -43.3	87.3	0.873 \pm 0.105	0.107	0.168	10.6
	16 8.73	104	0.370 \pm 0.089	0.112	1.40	11.2
	17 30.5	83.3	0.155 \pm 0.074	0.106	2.72	10.9
	18 69.6	104	1.06 \pm 0.12	0.111	1.15	11.1
	19 20.1	95.8	0.888 \pm 0.107	0.109	-1.99	10.9
	20 20.7	111	1.04 \pm 0.12	0.115	1.20	11.4
	21 7.66	104	0.677 \pm 0.102	0.113	9.25	10.7
	22 99.5 \pm 57.7	95.1	0.677 \pm 0.102	0.110	1.49	11.4
	23 15.1	81.0	1.50 \pm 0.13	0.107	2.00	11.0
	24 23.5	74.7	0.179 \pm 0.075	0.106	-1.64	10.9
	25 -16.0	71.0	0.133 \pm 0.073	0.105	-1.63	11.2
	26 -3.81	95.5	0.884 \pm 0.115	0.111	38.5 \pm 7.3	11.2
	27 103 ^(b)	104 ^(b)	0.740 \pm 0.104 ^(b)	0.112 ^(b)	24.2 \pm 7.0 ^(b)	11.1 ^(b)
May	28 -14.2	85.8	0.759 \pm 0.106	0.107	31.7 \pm 7.3	11.1
	29 17.5	87.0	0.629 \pm 0.101	0.107	37.0 \pm 7.0	11.2
	30 -13.2	77.0	0.0265	0.105	4.26	11.1
	1 3.09	79.9	0.131 \pm 0.073	0.105	3.23	11.0
	2 -41.1	91.4	0.555 \pm 0.094	0.108	26.7 \pm 7.2	11.3
	3 305 \pm 98	97.3	0.562 \pm 0.096	0.110	26.2 \pm 7.1	11.4
	4 9.62	93.2	0.681 \pm 0.102	0.108	21.9 \pm 7.2	11.3
	5 71.0	102	0.692 \pm 0.104	0.110	26.3 \pm 7.4	11.5
	6 26.5	85.1	0.102	0.106	14.0 \pm 6.9	11.8
	7 35.3	83.3	0.280 \pm 0.081	0.105	-1.80	11.3
	8 -37.0	89.2	0.729 \pm 0.102	0.107	2.85	11.2
	9 24.1	89.5	0.525 \pm 0.095	0.107	28.5 \pm 7.4	11.4
	10 0.147	105	0.844 \pm 0.110	0.111	40.3 \pm 7.3	11.1
	11 -20.9	81.8	0.444 \pm 0.084	0.105	26.3 \pm 7.4	11.8
	12 23.0	87.3	1.36 \pm 0.13	0.107	35.6 \pm 7.5	11.4
	13 161 \pm 55	80.7	0.892 \pm 0.107	0.106	1.81	11.2
	14 -8.73	76.6	0.198 \pm 0.077	0.105	0.881	11.6
	15 -38.1	75.9	0.168 \pm 0.076	0.105	-7.03	11.9
	16 61.8	108	1.04 \pm 0.11	0.113	25.1 \pm 7.3	11.6
	17 79.6	86.6	0.925 \pm 0.111	0.107	45.5 \pm 7.3	11.2

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
May	18	9.1	84.4	0.818 ± 0.106	0.106	41.4 ± 7.9
	19	73.3	84.0	0.0699 ± 0.0098	0.106	17.3 ± 6.9
	20	-24.3	85.1	0.981 ± 0.108	0.106	1.04
	21	-1.09	65.1	0.297 ± 0.080	0.101	2.42
	22	10.8	60.7	0.131 ± 0.069	0.0992	4.22
	23	32.4	98.8	0.744 ± 0.104	0.110	3.24
	24	193 ± 68	96.9	0.895 ± 0.107	0.109	-4.18
	25	72.2	72.9	0.651 ± 0.104	0.119	3.33
	26	-30.3	97.3	0.481 ± 0.091	0.110	6.44
	27	23.6	78.1	0.544 ± 0.092	0.105	-0.139
	28	-8.92	70.7	0.101	0.103	0.414
	29	-6.44	72.9	0.0666	0.104	1.41
	30	8.66	72.2	0.132 ± 0.072	0.104	0.936
	31	17.9	94.0	0.799 ± 0.104	0.108	-1.15
June	1	12.8	78.8	0.703 ± 0.098	0.106	-2.82
	2	123 ± 52	79.6	0.840 ± 0.118	0.120	11.1
	3	21.7	87.0	0.766 ± 0.107	0.108	1.15
	4	-18.2	73.3	0.354 ± 0.085	0.105	0.481
	5	-4.03	66.2	0.238 ± 0.076	0.103	2.80
	6	30.0	79.9	0.770 ± 0.100	0.106	1.54
	7	-46.6	99.2	0.947 ± 0.114	0.111	15.9 ± 6.2
	8	88.4	88.8	0.522 ± 0.094	0.108	7.84
	9	46.6	98.1	0.544 ± 0.098	0.109	5.07
	10	10.3	79.6	0.522 ± 0.094	0.105	-6.44
	11	-11.3	84.7	0.451 ± 0.090	0.106	3.40
	12	12.8	85.5	0.333 ± 0.083	0.106	-1.18
	13	22.3	79.6	0.570 ± 0.097	0.105	-1.59
	14	158 ± 61	112	0.944 ± 0.123	0.135	5.77
	15	-38.5	101	0.844 ± 0.118	0.131	5.59
	16	-0.262	91.4	0.988 ± 0.128	0.129	27.8 ± 6.9
	17	37.7	91.8	0.770 ± 0.115	0.129	1.22
	18	53.7	89.2	0.193 ± 0.089	0.128	0.0999
	19	55.1	72.9	0.0648	0.124	-1.09
	20	188 ± 73	110	0.736 ± 0.118	0.134	-0.346
	21	-4.22	89.5	0.725 ± 0.116	0.128	4.18

**Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)**

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
June	22	9.21	99.9	0.722 ± 0.108	0.121	7.44
	23	85.1	100	0.503 ± 0.101	0.121	-4.96
	24	148 ± 62	102	0.755 ± 0.113	0.121	4.55
	25	102 ± 55	79.6	0.216 ± 0.082	0.116	5.85
	26	32.6	79.6	0.151 ± 0.080	0.116	0.0688
	27	93.2	102	0.858 ± 0.112	0.122	107 ± 7
	28	48.8	105	0.992 ± 0.119	0.122	-0.166
	29	-30.8	121	0.751 ± 0.113	0.127	2.58
	30	36.6	131	0.821 ± 0.115	0.130	0.518
July	1	59.2	82.1	0.433 ± 0.095	0.118	7.29
	2	7.44	74.7	0.0211 ± 0.0210	0.115	-2.75
	3	53.3	79.2	0.106	0.117	5.25
	4	164 ± 74	109	0.729 ± 0.109	0.124	0.944
	5	74.0	93.6	0.226 ± 0.086	0.120	1.26
	6	221 ± 82	110	0.918 ± 0.119	0.124	4.59
	7	62.9	98.1	0.703 ± 0.105	0.122	0.444
	8	-19.2	119	0.944 ± 0.123	0.128	0.925
	9	40.7	96.9	0.226 ± 0.088	0.122	2.72
	10	93.2 ± 59.7	88.1	0.197 ± 0.085	0.120	5.22
	11	107	109	1.04 ± 0.13	0.124	5.33
	12	102 ± 54	95.5	0.770 ± 0.108	0.121	0.313
	13	106 ± 60	103	0.640 ± 0.109	0.123	4.85
	14	9.18	102	0.548 ± 0.104	0.122	1.10
	15	119 ± 55	95.8	0.999 ± 0.120	0.121	-6.59
	16	17.6	118	0.677 ± 0.108	0.127	-7.29
	17	47.0	97.7	0.414 ± 0.095	0.122	4.85
	18	74.0	92.1	0.400 ± 0.096	0.121	-4.59
	19	170 ± 65	102	1.35 ± 0.13	0.122	11.5 ± 6.7
	20	37.7	104	0.888 ± 0.115	0.125	-0.803
	21	51.8	89.2	0.814 ± 0.114	0.121	5.44
	22	57.4	110	0.729 ± 0.109	0.126	11.6 ± 5.2
	23	56.2	117	0.592 ± 0.107	0.129	4.37
	24	6.59	108	0.315 ± 0.094	0.126	1.64
	25	103 ± 60	101	0.607 ± 0.103	0.124	1.14
						8.55

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
July	127 \pm 58	111	1.29 \pm 0.13	0.127	-0.138	8.40
	106 \pm 57	96.6	0.633 \pm 0.108	0.128	0.107	8.14
	10.4	89.9	0.581 \pm 0.105	0.126	1.51	8.36
	47.7	103	0.414 \pm 0.099	0.129	1.05	8.14
	54.0	81.4	0.322 \pm 0.093	0.124	7.96	8.29
	-26.5	88.4	0.170 \pm 0.087	0.126	1.46	8.47
August	91.4	97.7	0.361 \pm 0.098	0.128	1.20	11.1
	32.4	105	0.633 \pm 0.114	0.130	6.62	10.8
	170 \pm 70	107	0.733 \pm 0.110	0.124	1.89	11.1
	135 \pm 61	98.1	0.688 \pm 0.110	0.122	41.1 \pm 7.4	11.0
	192 \pm 79	114	0.633 \pm 0.108	0.126	4.96	10.8
	280 \pm 92	98.4	0.337 \pm 0.091	0.122	1.81	11.0
	164 \pm 69	84.7	0.219 \pm 0.083	0.119	7.70	10.8
	286 \pm 91	114	0.858 \pm 0.120	0.126	2.23	11.2
	125 \pm 62	112	0.722 \pm 0.108	0.125	10.9 \pm 6.4	10.7
	82.5	98.8	0.437 \pm 0.096	0.120	0.722	11.2
	83.6	84.4	0.574 \pm 0.097	0.117	0.810	11.3
	104 \pm 49	86.6	0.555 \pm 0.100	0.118	5.55	10.8
	10.3	78.1	0.208 \pm 0.083	0.115	-0.300	11.5
	83.3	87.0	0.260 \pm 0.086	0.118	-0.551	11.2
	178 \pm 66	103.0	0.784 \pm 0.110	0.121	1.14	11.1
	54.4	89.2	0.666 \pm 0.107	0.120	4.59	10.9
	38.9	97.3	0.377 \pm 0.094	0.121	-3.40	11.1
	38.9	85.8	0.422 \pm 0.093	0.119	3.07	11.0
	94.0	99.2	1.21 \pm 0.17	0.122	0.162	11.1
	81.0	92.5	0.300 \pm 0.090	0.120	1.77	11.1
	59.9	83.6	0.191 \pm 0.082	0.119	3.48	11.2
	79.6	86.6	0.312 \pm 0.091	0.119	0.233	11.3
	148 \pm 55	108	0.914 \pm 0.119	0.124	5.88	10.9
	79.9	118	0.688 \pm 0.110	0.125	-4.22	11.5
	38.9	101	0.477 \pm 0.100	0.121	-0.140	11.4
	44.8	104	0.999 \pm 0.120	0.121	-0.492	11.4
	1.01	112	0.570 \pm 0.103	0.124	2.08	11.4
	75.5	97.7	0.204 \pm 0.084	0.120	0.895	11.6
	43.3	102	0.673 \pm 0.108	0.121	4.33	10.9

**Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)**

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
August 30	178 ± 68	107	1.11 ± 0.12	0.122	4.40	11.2
	227 ± 70	93.2	1.01 ± 0.12	0.120	-2.02	11.5
September 1	195 ± 72	120	1.08 ± 0.13	0.127	-4.40	11.4
2	52.2	137	4.85 ± 0.23	0.131	-2.65	11.5
3	119 ± 44	95.1	1.40 ± 0.13	0.120	5.81	11.0
4	38.1	96.9	1.51 ± 0.14	0.121	-1.05	11.3
5	72.5	75.1	0.273 ± 0.085	0.115	1.21	11.1
6	-0.0622	124	6.03 ± 0.25	0.132	6.92	11.5
7	164 ± 59	98.8	1.37 ± 0.14	0.134	-1.70	11.1
8	218 ± 83	130	1.30 ± 0.13	0.130	3.77	11.5
9	128 ± 61	109	0.873 ± 0.114	0.124	-5.03	11.4
10	194 ± 89	120	0.385 ± 0.096	0.127	6.11	11.1
11	235 ± 92	107	0.265 ± 0.087	0.123	6.59	11.2
12	289 ± 87	114	0.947 ± 0.123	0.124	1.10	11.2
13	208 ± 79	107	0.847 ± 0.119	0.123	1.46	11.4
14	208 ± 75	112	0.921 ± 0.120	0.124	3.07	11.8
15	88.8	9770	0.833 ± 0.108	0.120	-1.86	11.5
16	95.5	96.2	0.603 ± 0.103	0.120	0.585	11.2
17	18.3	83.3	0.151 ± 0.080	0.117	-0.888	11.6
18	81.8	82.1	0.0581	0.117	2.42	10.9
19	204 ± 73	103	0.759 ± 0.106	0.121	3.29	11.2
20	162 ± 63	126	1.02 ± 0.12	0.124	-3.68	11.6
21	64.8	111	0.796 ± 0.111	0.124	0.636	11.1
22	82.5	123	0.858 ± 0.120	0.128	6.44	11.2
23	22.9	107	0.984 ± 0.118	0.123	-0.081	11.5
24	31.6	87.7	0.201 ± 0.084	0.119	-2.93	11.2
25	199 ± 74	81.0	0.159 ± 0.080	0.117	-4.66	11.8
26	219 ± 76	99.5	0.651 ± 0.104	0.121	3.13	10.9
27	91.4	101	0.755 ± 0.113	0.122	-0.403 ± -0.167	11.4
28	1020	105	0.755 ± 0.113	0.123	0.755	11.2
29	108 ± 41	108	0.773 ± 0.108	0.124	33.9 ± 7.5	11.4
30	82.1	99.9	0.773 ± 0.108	0.121	4.03	10.8

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
October 1	55.9	85.5	0.141 \pm 0.080	0.119	3.40	11.5
2	112 \pm 60	81.4	0.158 \pm 0.080	0.118	1.28	11.4
3	146 \pm 57	100	0.892 \pm 0.116	0.122	-2.26	11.3
4	164 \pm 67	119	0.873 \pm 0.122	0.127	5.18	11.0
5	93.2	102	0.640 \pm 0.102	0.121	-2.26	11.4
6	72.5	97.7	0.744 \pm 0.112	0.121	-5.25	11.4
7	84.0	93.2	0.703 \pm 0.105	0.120	0.814	11.5
8	93.2 \pm 50	75.5	0.240 \pm 0.084	0.115	-2.99	11.4
9	19.2	75.1	0.101	0.115	-1.02	11.1
10	85.5	98.8	0.744 \pm 0.112	0.121	2.66	11.1
11	104 \pm 49	103	0.788 \pm 0.110	0.122	7.10	11.1
12	55.1	96.2	0.881 \pm 0.114	0.119	-2.50	11.4
13	327 \pm 91	101	0.799 \pm 0.112	0.120	-0.218	11.5
14	81.8	92.5	0.818 \pm 0.114	0.118	-1.24	11.3
15	36.0	79.9	0.210 \pm 0.082	0.116	3.16	11.1
16	34.6	77.7	0.156 \pm 0.080	0.115	2.26	11.3
17	102.0	107	0.944 \pm 0.113	0.121	-0.233	11.3
18	114 \pm 49	96.2	0.836 \pm 0.109	0.119	-2.28	11.7
19	63.6	109	0.662 \pm 0.106	0.124	-5.11	11.6
20	107	109	0.707 \pm 0.106	0.124	-2.11	11.5
21	59.2 \pm 23.1	41.1	0.773 \pm 0.101	0.102	0.0241	11.3
22	75.9 \pm 41.0	73.3	0.429 \pm 0.107	0.137	1.85	11.3
23	68.8	79.2	0.237 \pm 0.083	0.117	-0.525	11.4
24	181 \pm 73	101	0.503 \pm 0.101	0.121	8.25	11.1
25	106 \pm 45	104	1.03 \pm 0.12	0.122	-0.437	11.7
26	120 \pm 54	106	0.673 \pm 0.108	0.123	6.36	11.1
27	16.7	96.6	0.725 \pm 0.109	0.121	-2.96	11.4
28	77.7	91.8	0.784 \pm 0.110	0.120	0.403	11.4
29	70.7	84.0	0.170 \pm 0.082	0.118	2.64	11.3
30	99.2 \pm 55.5	78.4	0.128 \pm 0.077	0.117	3.49	11.1
31	85.5	105	0.833 \pm 0.117	0.122	-0.246	11.3

**Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (continued)**

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^(a)	Activity	LOS ^(a)	Activity	LOS ^(a)
November	128 \pm 47	99.9	0.121 \pm 0.013	0.121	0.238	11.1
	109 \pm 49	96.6	0.962 \pm 0.115	0.121	-12.9	12.0
	160 \pm 67	108	0.781 \pm 0.109	0.124	-1.81	11.7
	40.7	97.3	0.844 \pm 0.110	0.121	-1.22	11.6
	23.0	78.1	0.226 \pm 0.084	0.117	0.574	11.1
	21.9	77.7	0.0944	0.117	-0.807	11.4
	168 \pm 69	107	0.744 \pm 0.112	0.123	-8.18	11.5
	45.1	102	0.899 \pm 0.117	0.122	-0.377	11.4
	89.2	94.0	0.784 \pm 0.110	0.119	-0.644	11.5
	103 \pm 45	94.4	0.969 \pm 0.116	0.119	-3.30	11.5
	65.9	89.9	0.611 \pm 0.104	0.118	-0.433	11.6
	52.2	74.4	0.0992	0.114	4.11	11.6
	7.62	70.3	0.0681	0.112	1.68	11.4
	223 \pm 80	114	0.881 \pm 0.114	0.124	-1.17	11.5
	58.1	98.1	0.703 \pm 0.105	0.120	-0.818	11.7
	44.0	107	0.607 \pm 0.103	0.123	-7.36	11.9
	63.3	108	0.123 \pm 0.017	0.123	-0.437	11.3
	114 \pm 54	102	0.792 \pm 0.111	0.122	-0.792	11.1
	64.8	87.7	0.139 \pm 0.080	0.119	-7.25	11.5
	68.1	84.0	0.131 \pm 0.079	0.118	1.30	11.3
	213 \pm 83	131.0	0.130 \pm 0.017	0.130	-4.40	11.2
	40.0	99.2	0.533 \pm 0.101	0.121	-1.46	11.5
	53.7	101	0.759 \pm 0.114	0.123	-0.485	11.4
	36.1	78.8	0.104	0.118	-1.26	11.4
	88.4 \pm 53	79.6	0.212 \pm 0.085	0.118	2.29	11.5
	38.1	73.3	0.106	0.116	1.76	11.4
	9.40	75.9	0.127 \pm 0.079	0.117	10.9	11.1
	123 \pm 55	108	0.944 \pm 0.123	0.125	1.15	11.5
	234 \pm 84	122	1.02 \pm 0.12	0.130	-0.851	11.5
	70.3	95.8	0.796 \pm 0.111	0.121	2.24	11.4

Table 6-3. Daily monitoring results for gross alpha, gross beta, and tritium in the sanitary sewer effluent, 2000 (concluded)

Date	Gross alpha ($\mu\text{Bq/mL}$)		Gross beta (mBq/mL)		Tritium (mBq/mL)	
	Activity	LOS ^a	Activity	LOS ^a	Activity	LOS ^a
December 1	126 ± 54.1	87.0	0.625 ± 0.100	0.120	-8.29	12.1
2	69.9	93.2	0.574 ± 0.103	0.121	-2.94	11.2
3	88.1 ± 54.6	85.8	0.218 ± 0.085	0.119	-0.533	11.2
4	62.2	93.2	0.272 ± 0.087	0.121	0.396	11.6
5	57.0	98.1	0.755 ± 0.113	0.122	0.451	11.5
6	67.3	122	1.04 ± 0.13	0.128	-4.81	11.1
7	-13.9	110	0.973 ± 0.117	0.125	1.81	12.1
8	-66.2	137	1.10 ± 0.132	0.132	0.655	12.2
9	23.6	98.4	0.877 ± 0.114	0.122	5.18	12.0
10	66.6	81.0	0.225 ± 0.086	0.118	1.34	11.8
11	15.1	81.4	0.243 ± 0.085	0.119	0.914	12.2
12	29.2	105	0.833 ± 0.117	0.124	-2.23	11.2
13	176 ± 67	101	0.818 ± 0.114	0.121	3.13	11.2
14	89.2	109	0.892 ± 0.116	0.123	5.14	10.9
15	95.8	102	0.955 ± 0.115	0.121	1.42	11.0
16	96.9	100	0.918 ± 0.119	0.121	-5.62	11.4
17	61.1	81.8	0.188 ± 0.081	0.117	1.70	11.2
18	70.7	77.3	0.275 ± 0.085	0.116	-1.13	11.5
19	102	109	0.973 ± 0.117	0.123	-4.37	11.5
20	68.8	109	0.818 ± 0.114	0.123	1.15	11.2
21	143 ± 63	108	0.770 ± 0.108	0.122	-5.59	11.0
22	120 ± 56	105	0.747 ± 0.112	0.121	-11.6	11.5
23	107 ± 49	94.7	0.821 ± 0.115	0.119	-1.72	10.7
24	48.8	79.2	0.199	0.115	5.96	10.3
25	98.8 ± 55.3	75.9	0.130 ± 0.077	0.114	3.22	10.5
26	82.9 ± 53.0	75.5	0.084	0.114	3.30	10.4
27	72.9	77.0	0.180 ± 0.079	0.115	3.96	10.2
28	96.6 ± 48.3	92.5	0.614 ± 0.104	0.119	3.13	10.4
29	91.8 ± 45.9	89.9	0.633 ± 0.101	0.118	3.74	10.7
30	82.1	89.5	0.666 ± 0.107	0.118	1.22	10.4
31	-19.7	76.2	0.640 ± 0.102	0.115	4.66	10.4

Note: The activities shown in this table are measured concentrations and their associated 2σ counting errors. Activities do not include the 2σ counting errors when the measured concentrations are less than the limit of sensitivity (LOS). See main volume, Chapter 14.

a LOS = Limit of sensitivity

b The daily monitoring results are not available. The results shown for this date are the monitoring results for the weekly composite sample for the sampling period of April 26 through May 3, 2000.



Table 6-4. Weekly composite results for tritium (mBq/mL) for the LWRP effluent, 2000

Composite dates	Activity ^(a)	LOS ^(b)	Composite dates	Activity ^(a)	LOS ^(b)
12/27/99–1/2/00	1.71	10.7	7/3–7/9	-1.99	8.44
1/3–1/9	-7.29	10.9	7/10–7/16	-7.77	12.0
1/10–1/16	1.81	10.5	7/17–7/23	-6.99	11.9
1/17–1/23	-6.18	11.0	7/24–7/30	-0.40	8.29
1/24–1/30	-0.847	11.4	7/31–8/6	6.22	10.8
1/31–2/6	2.77	10.8	8/7–8/13	-7.96	11.5
2/7–2/13	-7.55	11.1	8/14–8/20	1.85	11.4
2/14–2/20	1.71	11.0	8/21–8/27	0.992	11.4
2/21–2/27	2.92	11.0	8/28–9/3	0.729	11.3
2/28–3/5	-0.414	10.8	9/4–9/10	-1.68	11.4
3/6–3/12	1.02	11.0	9/11–9/17	-0.540	11.3
3/13–3/19	8.03	10.7	9/18–9/24	4.03	11.3
3/20–3/26	-0.958	11.2	9/25–10/1	-1.37	11.5
3/27–4/2	-2.60	11.2	10/2–10/8	-1.55	11.1
4/3–4/9	2.11	10.9	10/9–10/15	2.68	11.4
4/10–4/16	2.94	10.7	10/16–10/22	-5.99	11.6
4/17–4/23	5.33	11.1	10/23–10/29	-0.403	11.0
4/24–4/30	-0.718	11.1	10/30–11/5	-7.77	11.7
5/1–5/7	2.33	11.3	11/6–11/12	1.30	11.5
5/8–5/14	-0.633	11.2	11/13–11/19	-2.42	11.4
5/15–5/21	2.38	11.2	11/20–11/26	0.681	11.4
5/22–5/28	-5.81	12.2	11/27–12/3	-4.22	11.4
5/29–6/4	3.85	12.0	12/4–12/10	-2.37	11.5
6/5–6/11	4.14	10.5	12/11–12/17	-2.22	11.0
6/12–6/18	-2.16	11.8	12/18–12/24	1.89	10.5
6/19–6/25	1.56	8.47	12/25–12/31	7.40	10.4
6/26–7/2	-2.42	8.70	1/1–1/7	2.32	10.1

a The activities shown in this table are measured concentrations and their associated 2σ counting errors. Activities do not include the 2σ counting errors when the measured concentrations are less than the limit of sensitivity (LOS). See main volume, Chapter 14.

b LOS = Limit of sensitivity

Table 6-5. Weekly composite results for metals in LLNL sanitary sewer effluent, 2000

Composite dates	Parameter (mg/L)								
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
12/29/99-1/5/00	0.015	<0.0020	<0.0050	0.066	0.28	<0.00020	0.011	0.029	0.56
1/5-1/12	<0.010	<0.0020	<0.0050	<0.010	0.077	<0.00020	<0.0050	0.0027	0.17
1/12-1/19	<0.010	0.0067	0.0060	0.067	0.34	0.00076	0.015	0.031	0.70
1/19-1/26	<0.010	<0.0040	<0.0050	0.020	0.13	<0.00020	0.0079	0.018	0.37
1/26-2/2	<0.010	<0.0020	<0.010	<0.010	0.090	<0.00020	0.0050	0.0040	0.16
2/2-2/9	<0.010	0.0063	<0.010	0.030	0.19	0.00029	0.010	0.028	0.42
2/9-2/16	<0.010	0.0025	<0.010	0.020	0.20	0.00023	0.0080	0.012	0.25
2/16-2/23	<0.010	0.0077	<0.010	0.034	0.21	0.00052	0.014	0.016	0.43
2/23-3/1	<0.010	<0.0020	<0.010	<0.010	0.18	0.00057	0.012	0.016	0.47
3/1-3/8	<0.010	0.0037	<0.010	0.072	0.30	0.0022	0.0177	0.053	0.79
3/8-3/15	<0.010	0.0028	<0.010	0.040	0.30	0.00079	0.012	0.039	0.62
3/15-3/22	<0.010	0.0028	<0.010	0.020	0.21	0.00068	0.0090	0.021	0.47
3/22-3/29	<0.010	0.0021	<0.010	0.020	0.25	0.0020	0.011	0.025	0.57
3/29-4/5	<0.010	0.0021	<0.0050	<0.010	0.072	<0.00020	<0.010	0.0063	0.20
4/5-4/12	<0.010	<0.0020	<0.0050	<0.010	0.076	0.00034	<0.0050	0.012	0.20
4/12-4/19	<0.010	0.0052	<0.0050	0.030	0.13	0.00061	0.0070	0.020	0.27
4/19-4/26	<0.010	0.0066	<0.0050	0.084	0.35	0.00073	0.011	0.036	0.55
4/26-5/3	<0.010	0.0071	<0.010	0.14	0.32	0.00075	0.011	0.072	0.57
5/3-5/10	<0.010	0.010	<0.0050	0.11	0.32	0.00034	0.006	0.041	0.54
5/10-5/17	<0.010	0.0033	0.0070	0.090	0.26	0.00058	0.011	0.049	0.53
5/17-5/24	<0.010	0.0076	<0.0050	0.13	0.28	0.00056	0.012	0.019	0.58
5/24-5/31	<0.010	0.0068	<0.0050	0.20	0.47	0.00039	0.013	0.069	0.86
5/31-6/7	<0.010	<0.0040	<0.0050	0.090	0.34	0.00035	0.010	0.039	0.63
6/7-6/14	<0.010	0.0062	<0.0050	0.15	0.45	0.00075	0.030	0.026	0.61
6/14-6/21	<0.010	0.0086	<0.0050	0.14	0.69	0.00042	0.041	0.049	0.91
6/21-6/28	0.050	0.0068	<0.0050	0.16	0.38	0.00039	0.082	0.049	0.69
6/28-7/5	0.040	0.0059	<0.0050	0.11	0.54	0.00055	0.042	0.051	0.64
7/6-7/12	0.020	0.0060	<0.0050	0.090	0.41	0.0010	0.026	0.040	0.62
7/12-7/19	0.030	0.0089	0.0060	0.14	0.72	0.0028	0.029	0.065	1.1
7/19-7/26	<0.010	0.0057	<0.0050	0.096	0.46	0.0017	0.022	0.056	0.91
7/26-8/2	<0.010	0.0045	<0.0050	0.056	0.35	0.00059	0.012	0.021	0.55
8/2-8/9	<0.010	0.0059	<0.0050	0.054	0.28	0.00032	0.0090	0.043	0.33
8/9-8/16	<0.010	0.0042	<0.0050	0.040	0.21	0.00025	0.0070	0.013	0.39
8/16-8/23	<0.010	0.0024	<0.0050	<0.010	0.10	<0.00020	<0.0050	0.0030	0.16
8/23-8/30	<0.010	0.010	<0.0050	0.15	0.59	0.00097	0.019	0.045	1.0
8/30-9/6	0.020	0.0047	<0.0050	0.061	0.43	0.00062	0.011	0.048	0.63

**Table 6-5. Weekly composite results for metals in LLNL sanitary sewer effluent, 2000 (concluded)**

Composite dates	Parameter (mg/L)								
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
9/6-9/13	<0.010	0.0066	<0.0050	0.053	0.26	0.00046	0.0090	0.018	0.39
9/13-9/20	<0.010	0.0055	<0.0050	0.10	0.54	0.00053	0.011	0.079	0.70
9/20-9/27	<0.010	0.0031	<0.0050	0.14	0.64	0.0015	0.015	0.078	0.94
9/27-10/4	<0.010	0.0050	<0.0050	0.16	0.83	0.0012	0.024	0.070	1.1
10/4-10/11	0.020	0.015	<0.0050	0.13	0.58	0.0010	0.014	0.063	0.92
10/11-10/18	<0.010	0.0058	<0.0050	0.090	0.43	0.0017	0.037	0.040	0.87
10/18-10/25	0.010	0.0099	<0.0050	0.23	0.40	0.0013	0.017	0.041	1.0
10/25-11/1	<0.010	0.0047	<0.0050	0.14	0.50	0.00085	0.015	0.028	0.90
11/1-11/8	<0.010	0.0046	<0.0050	0.18	0.50	0.00074	0.011	0.023	0.87
11/8-11/15	<0.010	0.0035	<0.0050	0.11	0.47	0.00030	0.013	0.058	0.86
11/15-11/22	<0.010	0.0036	<0.0050	0.080	0.33	0.0011	0.010	0.025	0.65
11/22-11/29	<0.010	0.0040	<0.0050	0.11	0.25	0.0013	0.0080	0.017	0.50
11/29-12/6	<0.010	<0.0020	<0.0050	0.050	0.22	0.00062	0.0070	0.012	0.37
12/6-12/13	<0.010	0.0020	<0.0050	0.060	0.35	0.00055	0.020	0.020	0.59
12/13-12/20	<0.010	<0.0020	<0.010	0.030	0.18	0.00032	0.0070	0.010	0.22
12/20-12/27	<0.010	<0.0020	<0.0100	0.030	0.18	<0.00020	0.0070	0.010	0.35
12/27/00-1/3/01	<0.010	<0.0020	<0.0050	<0.010	0.056	<0.00020	<0.0050	0.0023	0.079

Summary of monthly composite results

Detection frequency	8/53	42/53	3/53	46/53	53/53	45/53	48/53	53/53	53/53
Minimum (mg/L)	<0.010	<0.0020	<0.0050	<0.010	0.056	<0.00020	<0.0050	0.0023	0.079
Maximum (mg/L)	0.050	0.015	<0.010	0.23	0.83	0.0028	0.082	0.079	1.1
Median (mg/L)	<0.010	0.0046	<0.0050	0.072	0.32	0.00057	0.011	0.028	0.57
IQR ^(a) (mg/L)	— ^(b)	0.0041	— ^(b)	0.10	0.24	0.00053	0.0070	0.032	0.40
50% of EPL ^(c) (mg/L)	0.1	0.03	0.07	0.31	0.5	0.005	0.305	0.1	1.5
Maximum/50% of EPL	0.50	0.50	0.14	0.74	1.7	0.56	0.27	0.79	0.73
Median/50% of EPL	0.10	0.15	0.071	0.23	0.64	0.11	0.036	0.28	0.38

a IQR = Interquartile range

b Because of the large number of nondetects, the interquartile range is omitted. See main volume, Chapter 14.

c EPL = Effluent pollutant limit

Table 6-6. Monthly 24-hour composite results for metals in LLNL sanitary sewer effluent, 2000

Sample date	Parameter (mg/L)											
	Ag	Al	As	Be	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn
1/5	<0.010	0.40	<0.0020	<0.00050	<0.0050	0.020	0.13	1.6	<0.00020	0.0080	0.011	0.27
2/2	<0.010	0.3	<0.0020	<0.00050	<0.0050	<0.010	0.055	0.69	0.00039	0.0060	0.0049	0.21
3/8	<0.010	0.56	<0.0020	<0.00050	<0.0050	0.030	0.12	1.6	0.00021	0.0066	0.036	0.27
4/5	<0.010	1.4	<0.0020	<0.00020	<0.0050	0.030	0.10	2.2	0.00021	0.0088	0.0084	0.23
5/3	<0.010	0.7	<0.0020	<0.00050	<0.010	0.050	0.12	1.9	<0.00020	<0.0050	0.011	0.18
6/7	<0.010	0.39	<0.0020	<0.00020	<0.0050	0.020	0.10	1.2	<0.00020	0.0050	0.0056	0.20
7/6	0.020	1.5	0.0037	<0.00050	<0.0050	0.068	0.34	3.9	0.00023	0.029	0.032	0.44
8/2	<0.010	0.5	<0.0020	<0.00050	<0.0050	0.020	0.16	1.2	0.00022	<0.0050	0.014	0.19
9/7	<0.010	0.4	0.0062	<0.00050	<0.0050	0.020	0.16	1.1	<0.00020	<0.0050	0.0074	0.17
10/4	<0.010	0.3	0.0095	<0.00050	<0.0050	0.030	0.16	1.1	<0.00020	0.0050	0.011	0.16
11/7	<0.010	0.9	0.0024	<0.00050	<0.0050	0.097	0.25	2.8	0.00067	0.0070	0.015	0.31
12/7	<0.010	0.5	<0.0020	<0.00050	<0.0050	0.030	0.20	1.7	0.00020	0.010	0.0090	0.29
Summary of monthly composite results												
Detection frequency	1/12	12/12	4/12	0/12	0/12	11/12	12/12	12/12	7/12	9/12	12/12	12/12
Minimum (mg/L)	<0.010	0.30	<0.0020	<0.00020	<0.0050	<0.010	0.055	0.69	<0.00020	<0.0050	0.0049	0.16
Maximum (mg/L)	0.020	1.5	0.0095	<0.00050	<0.010	0.097	0.34	3.9	0.00067	0.029	0.036	0.44
Median (mg/L)	<0.010	0.50	<0.0020	<0.00050	<0.0050	0.030	0.15	1.6	0.00021	0.0063	0.011	0.22
IQR ^(a) (mg/L)	— ^(b)	0.35	— ^(b)	— ^(b)	— ^(b)	0.015	0.055	0.80	0.000023	0.0032	0.0061	0.088
EPL ^(c) (mg/L)	0.2	— ^(d)	0.06	— ^(d)	0.14	0.62	1	— ^(d)	0.01	0.61	0.2	3.0
Maximum/EPL	0.10	— ^(d)	0.16	— ^(d)	0.071	0.016	0.34	— ^(d)	0.67	0.048	0.18	0.15
Median/EPL	0.050	— ^(d)	0.033	— ^(d)	0.036	0.048	0.15	— ^(d)	0.021	0.010	0.055	0.073

a IQR = Interquartile range

b Because of the large number of nondetects, the interquartile range is omitted. See main volume, Chapter 14.

c EPL = Effluent pollutant limit

d There is no EPL for this parameter; therefore, no comparison value can be calculated.

**Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000**

24-hour composite sample parameters	EPA Method	January	February	March	April	May	June
Alkalinity (mg/L)							
Bicarbonate alkalinity (as CaCO ₃)	310.1	189	225	216	194	179	228
Carbonate alkalinity (as CaCO ₃)		<5	16	<5	<5	<5	<5.2
Hydroxide alkalinity (as CaCO ₃)		<5	<5	<5	<5	<5	<3.2
Total alkalinity (as CaCO ₃)		189	241	216	194	179	228
Anions (mg/L)							
Bromide	300	<0.1	<0.1	<0.1	<0.1	0.1	0.3
Chloride	300	29	44	47	66	47	41
Fluoride	300	—(a)	—(a)	—(a)	—(a)	—(a)	—(a)
Fluoride	340.2	<0.05	0.061	0.073	0.074	0.06	0.062
Nitrate (as N)	353.2	<1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as NO ₃)	353.2	<4.4	<0.4	<0.4	<0.44	<0.4	<0.4
Nitrate plus nitrite (as N)	353.2	<1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrite (as N)	353.2	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
Nitrite (as NO ₂)	353.2	<0.07	0.066	<0.07	<0.065	<0.065	<0.065
Orthophosphate	365.1	15.5	16.9	0.902	15.3	16.2	19
Sulfate	300	7.4	12	11	9.7	8.1	9.2
Nutrients (mg/L)							
Ammonia nitrogen (as N)	350.1	41	56	54	37	35	52
Total Kjeldahl nitrogen	351.2	57	90	68	57	50	60
Total phosphorus (as P)	365.4	6.3	8.5	9.9	8.6	9.4	8
Oxygen demand (mg/L)							
Biochemical oxygen demand	SM-5210B	238	168	300	287	165	275
Chemical oxygen demand	410.4	910	370	680	625	515	597
Solids (mg/L)							
Total dissolved solids (TDS)	160.1	200	222	224	254	234	246
Total suspended solids (TSS)	160.2	295	140	435	396	209	342
Volatile solids	160.4	428	74	170	400	350	448
Settleable solids	160.5	48	2.5	50	40	35	40
Total metals (mg/L)							
Calcium	200.7	11	9.2	14	19	11	12
Magnesium	200.7	2.2	2.2	2.6	3.7	2.1	2.4
Potassium	200.7	17	21	19	17	17	19
Beryllium	210.2	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium	270.2	—(a)	—(a)	—(a)	—(a)	—(a)	—(a)
Selenium	7740	—(a)	—(a)	—(a)	—(a)	—(a)	—(a)
Selenium	SM-3114B	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total organic carbon (TOC) (mg/L)	415.1	44	72	65	46	69	67
Tributyltin (ng/L)	GC-FPD	250	—(b)	—(b)	—(b)	—(b)	—(b)

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)

24-hour composite sample parameters	EPA Method	July	August	September	October	November	December
Alkalinity (mg/L)							
Bicarbonate alkalinity (as CaCO ₃)	310.1	115	239	241	194	205	214
Carbonate alkalinity (as CaCO ₃)		<10	<10	<10	<10	<2.5	<5
Hydroxide alkalinity (as CaCO ₃)		<10	<10	<10	<10	<2.5	<5
Total alkalinity (as CaCO ₃)		115	239	241	194	205	214
Anions (mg/L)							
Bromide	300	<0.1	<0.1	<0.1	<0.1	<0.1	0.4
Chloride	300	17	45	84	63	35	87
Fluoride	300	—(a)	—(a)	—(a)	—(a)	<0.05	<0.1
Fluoride	340.2	0.051	0.16	0.28	0.15	—(a)	—(a)
Nitrate (as N)	353.2	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as NO ₃)	353.2	<2	<0.4	<0.4	<0.4	<0.4	<0.4
Nitrate plus nitrite (as N)	353.2	0.59	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrite (as N)	353.2	1	<0.02	0.02	<0.02	<0.02	0.02
Nitrite (as NO ₂)	353.2	3.4	<0.065	0.066	<0.065	<0.065	0.066
Orthophosphate	365.1	10.7	18	13	12.6	15.9	19.9
Sulfate	300	6.8	13	16	11	5.9	8.5
Nutrients (mg/L)							
Ammonia nitrogen (as N)	350.1	20	49	38	32	36	46
Total Kjeldahl nitrogen	351.2	28	56	48	55	52	56
Total phosphorus (as P)	365.4	5.9	7.5	7.5	5.4	8.9	9.7
Oxygen Demand (mg/L)							
Biochemical Oxygen Demand	SM-5210B	156	171	208	88	269	760
Chemical Oxygen Demand	410.4	457	405	320	260	572	450
Solids (mg/L)							
Total dissolved solids (TDS)	160.1	183	232	367	292	208	337
Total suspended solids (TSS)	160.2	91	170	450	130	380	140
Volatile solids	160.4	150	150	130	190	474	250
Settleable solids	160.5	23	18	50	12	50	6.5
Total metals (mg/L)							
Calcium	200.7	19	13	30	19	13	16
Magnesium	200.7	3.1	2.6	3.3	2.3	2.2	3
Potassium	200.7	12	20	21	16	16	22
Beryllium	210.2	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium	270.2	—(a)	—(a)	—(a)	—(a)	—(a)	<0.002
Selenium	7740	—(a)	—(a)	—(a)	—(a)	<2	—(a)
Selenium	SM-3114B	<0.002	<0.002	<0.002	<0.002	<0.002	—(a)
Total Organic Carbon (TOC) (mg/L)							
Total Organic Carbon (TOC) (mg/L)	415.1	45	63	54	48	41	55
Tributyltin (ng/L)	GC-FPD	40	—(b)	—(b)	—(b)	—(b)	—(b)

**Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)**

Grab sample parameters	EPA Method	January	February	March	April	May	June
Semivolatile organic compounds (µg/L)	625						
1,2,4-Trichlorobenzene		<2	<2	<2	<4	<2	<2
1,2-Dichlorobenzene		<2	<2	<2	<4	<2	<2
1,2-Diphenylhydrazine		<2	<2	<2	<4	<2	<2
1,3-Dichlorobenzene		<2	<2	<2	<4	<2	<2
1,4-Dichlorobenzene		<2	<2	<2	<4	<2	<2
2,4,5-Trichlorophenol		<5	<5	<5	<10	<5	<5
2,4,6-Trichlorophenol		<5	<5	<5	<10	<5	<5
2,4-Dichlorophenol		<2	<2	<2	<4	<2	<2
2,4-Dimethylphenol		<2	<2	<2	<4	<2	<2
2,4-Dinitrophenol		<10	<10	<10	<20	<10	<10
2,4-Dinitrotoluene		<2	<2	<2	<4	<2	<2
2,6-Dinitrotoluene		<2	<2	<2	<4	<2	<2
2-Chloronaphthalene		<2	<2	<2	<4	<2	<2
2-Chlorophenol		<2	<2	<2	<4	<2	<2
2-Methyl-4,6-dinitrophenol		<10	<10	<10	<20	<10	<10
2-Methylnaphthalene		<2	<2	<2	<4	<2	<2
2-Naphthylamine		<20	<20	<20	<40	<20	<20
2-Nitroaniline		<2	<2	<2	<4	<2	<2
2-Nitrophenol		<2	<2	<2	<4	<2	<2
3,3-Dichlorobenzidine		<5	<5	<5	<10	<5	<5
3-Nitroaniline		<2	<2	<2	<4	<2	<2
4-Bromophenylphenylether		<2	<2	<2	<4	<2	<2
4-Chloro-3-methylphenol		<5	<5	<5	<10	<5	<5
4-Chloroaniline		<2	<2	<2	<4	<2	<2
4-Chlorophenylphenylether		<2	<2	<2	<4	<2	<2
4-Nitroaniline		<5	<5	<5	<10	<5	<5
4-Nitrophenol		<5	<5	<5	<10	<5	<5
Acenaphthene		<2	<2	<2	<4	<2	<2
Acenaphthylene		<2	<2	<2	<4	<2	<2
Aldrin		<2	<2	<2	<4	<2	<2
Aniline		<5	<5	<5	<10	<5	<5
Anthracene		<2	<2	<2	<4	<2	<2
Benzidine		<20	<20	<20	<40	<20	<20
Benzo(a)anthracene		<2	<2	<2	<4	<2	<2
Benzo(a)pyrene		<2	<2	<2	<4	<2	<2

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)



Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)

Grab sample parameters	EPA Method	January	February	March	April	May	June
Semivolatile organic compounds (µg/L) (continued)	625						
Benzo(b)fluoranthene		<2	<2	<2	<4	<2	<2
Benzo(g,h,i)perylene		<2	<2	<2	<4	<2	<2
Benzo(k)fluoranthene		<2	<2	<2	<4	<2	<2
Benzoic Acid		27	<10	22	<20	70	<10
Benzyl Alcohol		5.6	21	6.4	6.7	21	6.6
BHC, alpha isomer		<2	<2	<2	<4	<2	<2
BHC, beta isomer		<2	<2	<2	<4	<2	<2
BHC, delta isomer		<2	<2	<2	<4	<2	<2
BHC, gamma isomer (Lindane)		<2	<2	<2	<4	<2	<2
Bis(2-chloroethoxy)methane		<2	<2	<2	<4	<2	<2
Bis(2-chloroethyl)ether		<2	<2	<2	<4	<2	<2
Bis(2-chloroisopropyl)ether		<2	<2	<2	<4	<2	<2
Bis(2-ethylhexyl)phthalate		<5	93	18	11	16	14
Butylbenzylphthalate		<2	<2	4.6	<4	3.1	<2
Chrysene		<2	<2	<2	<4	<2	<2
Di-n-octylphthalate		<2	<2	<2	<4	<2	<2
Dibenzo(a,h)anthracene		<3	<3	<3	<6	<3	<3
Dibenzofuran		<2	<2	<2	<4	<2	<2
Dibutylphthalate		<2	<2	<2	<4	<2	<2
Dieldrin		<3	<3	<3	<6	<3	<3
Diethylphthalate		4.2	6.3	11	12	6.1	15
Dimethylphthalate		<2	<2	<2	<4	<2	<2
Endosulfan I		<10	<10	<10	<20	<10	<10
Endosulfan II		<10	<10	<10	<20	<10	<10
Endosulfan sulfate		<3	<3	<3	<6	<3	<3
Endrin		<2	<2	<2	<4	<2	<2
Endrin aldehyde		<2	<2	<2	<4	<2	<2
Fluoranthene		<2	<2	<2	<4	<2	<2
Fluorene		<2	<2	<2	<4	<2	<2
Heptachlor		<2	<2	<2	<4	<2	<2
Heptachlor epoxide		<2	<2	<2	<4	<2	<2
Hexachlorobenzene		<2	<2	<2	<4	<2	<2
Hexachlorobutadiene		<2	<2	<2	<4	<2	<2
Hexachlorocyclopentadiene		<2	<2	<2	<4	<2	<2
Hexachloroethane		<2	<2	<2	<4	<2	<2

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)



Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)



Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)

**Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (continued)**

Grab sample parameters	EPA Method	January	February	March	April	May	June
Volatile organic compounds (µg/L) (continued)	624						
2-Chloroethylvinylether		<5	<5	<5	<5	<5	<10
2-Hexanone		<20	<20	<20	<20	<20	<20
4-Methyl-2-pentanone		<20	<20	<20	<20	<20	<20
Acetone		97	140	74	160	140	290
Benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane		<0.5	<0.5	0.57	<0.5	<0.5	<0.5
Bromoform		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide		<5	<5	<5	<5	<5	<5
Carbon tetrachloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane		<1	<1	<1	<1	<1	<1
Chloroform		9.5	5.1	14	12	15	12
Chloromethane		<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethanol		<1000	1400	<1000	<1000	<1000	<1000
Ethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Freon 113		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene chloride		<1	<1	<1	<1	<1	<1
Naphthalene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene		<0.5	1.2	<0.5	<0.5	0.71	0.63
Total xylene isomers		1.8	<1	<1	<1	<1	<1
trans-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl chloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

a Analytical method was changed by the contract analytical laboratory during the year. See adjacent row for additional data.

b Sampling required by permit on a semiannual basis

c Contract analytical laboratory changed from reporting p-cresol to m- and p-cresol results.

Table 6-7. Monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent, 2000 (concluded)

Grab sample parameters	EPA Method	July	August	September	October	November	December
Volatile organic compounds (µg/L) (continued)	624						
2-Chloroethylvinylether		<10	<10	<10	<10	<10	<10
2-Hexanone		<20	<20	<20	<20	<20	<20
4-Methyl-2-pantanone		<20	<20	<20	<20	<20	<20
Acetone		550	120	340	150	480	120
Benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide		<5	<5	<5	<5	<5	<5
Carbon tetrachloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroethane		<1	<1	<1	<1	<1	<1
Chloroform		15	9.1	14	11	6.6	11
Chloromethane		1.3	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,3-Dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethanol	4100	1200	<1000	<1000	<1000	<1000	<1000
Ethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Freon 113		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene chloride		<1	<1	<1	<1	<1	<1
Naphthalene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene		0.5	<0.5	1.5	<0.5	<0.5	0.65
Total xylene isomers		<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl chloride		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

d Sampling for this parameter is required on a semiannual rather than a monthly basis. An additional cyanide sample was taken in March to demonstrate return to compliance.

e No sample collected



SURFACE WATER MONITORING

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Introduction

Lawrence Livermore National Laboratory monitors surface water at the Livermore site, in surrounding regions of the Livermore Valley, and at Site 300 and vicinity in the nearby Altamont Hills. At the first two locales, LLNL monitors reservoirs and ponds, the LLNL swimming pool, the Drainage Retention Basin (DRB), rainfall, tap water, and storm water runoff. Water samples are analyzed for radionuclides and a wide range of nonradioactive constituents. The data shown for Site 300 and vicinity include surface water monitoring, rainfall, and storm runoff. Samples of this water are analyzed for radionuclides, high explosives (HE), total organic carbon, total organic halides, total suspended solids, conductivity, and pH. Chapter 7 of the main volume includes summary data tables and a detailed discussion and analysis of the data. This supplemental chapter presents the complete dataset for 2000, from which the summaries and analyses were prepared. These data supplement material provided in Chapter 7 of the main volume.

Storm Water

LLNL technologists collect storm water samples for nonradiological analysis directly into sample bottles for storm water runoff grab samples. Samples analyzed for tritium are collected in 250-mL, amber glass containers; samples for gross alpha and gross beta measurements are collected in 1000-mL polyethylene bottles. Results for Livermore site

routine tritium, gross alpha, and gross beta are presented in Table 7-1. Results for the tritium source investigation are presented in Table 7-2. Results for plutonium in filtered and unfiltered samples are presented in Table 7-3. Results for metals detected at the Livermore site are presented in Table 7-4. Table 7-5 summarizes results for nonradioactive compounds, physical and chemical properties, and anions in Livermore site storm water. Data for nondetections in Livermore site storm water are summarized in Table 7-6. Table 7-7 shows results for gross alpha, gross beta, tritium, and uranium in Site 300 storm water. Results for nonradioactive compounds and physical properties for Site 300 storm water are listed in Table 7-8. Results of dioxin analyses at Site 300 sampling location NLIN are presented in Table 7-9.

Rainfall

Rainfall is collected in stainless steel buckets mounted at specified locations about 1 m above the ground to prevent collection of splashback water. Samples are decanted into 250-mL amber glass with Teflon-lined lids. The tritium activity of each sample is measured in a laboratory by scintillation counting (EPA Method 906). Results are presented in Table 7-10.



Drainage Retention Basin

DRB discharge sampling locations (CDBX and WPDC), which monitor compliance with the Livermore site's Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision, are shown in the main volume, **Figure 7-2**. **Figure 7-16** of the main volume shows the sampling locations (CDBA and CDBC) used to monitor how water quality compares with maintenance goals and action levels. Weekly sampling for dissolved oxygen and temperature occurs at all eight locations identified in **Figure 7-16** of the main volume. Weekly turbidity measurements and monthly, quarterly, semiannual, and annual samples are collected at sample location CDBE.

Tables 7-11 and 7-12 show DRB discharge limits and water quality management levels, respectively. Tables 7-13 and 7-14 show the compliance monitoring data for samples collected at sample locations CDBX and WPDC. Monthly, quarterly, and semiannual maintenance monitoring data for 2000 that were collected at sample location CDBE are shown in Tables 7-15, 7-16, and 7-17. Table 7-18 provides the weekly field measurements collected from sample locations CDBA, CDBC, CDBD, CDBE, CDBF, CDBJ, CDBK, and CDBL. A seasonal inventory of plants and animals observed at the Livermore site is given in Table 7-19.

Other Waters

LLNL technologists sample surface and drinking water at and near the Livermore site and in the Livermore Valley using a tethered pail to collect water from surface sources; other locations are sampled directly from the outfall. Samples for tritium analysis are collected in 500-mL, argon-flushed glass containers; those for other radiological analyses are collected in acidified 1000-mL polyethylene bottles. Results are presented in Table 7-20.

**Table 7-1. Routine tritium, gross alpha, and gross beta sampling in storm water runoff at the Livermore site, 2000**

Parameter	Date	Arroyo Seco	
		Site influent ASS2	Site effluent ASW
Tritium (Bq/L)	1/11	-0.091 ± 2.390	0.129 ± 2.409
	2/14	-0.127 ± 1.998	0.252 ± 2.046
	3/8	-1.162 ± 2.017	0.366 ± 2.079
	4/17	—(a)	—(a)
Gross alpha (Bq/L)	1/11	0.015 ± 0.014	0.031 ± 0.022
	2/14	0.448 ± 0.148	0.714 ± 0.221
	3/8	0.056 ± 0.056	0.107 ± 0.058
Gross beta (Bq/L)	1/11	0.112 ± 0.020	0.189 ± 0.030
	2/14	1.040 ± 0.162	1.162 ± 0.184
	3/8	0.278 ± 0.061	0.194 ± 0.043

Parameter	Date	Arroyo Las Positas			
		Site influent			Site effluent
		ALPE	ALPO	GRNE	WPDC
Tritium (Bq/L)	1/11	0.222 ± 2.412	1.883 ± 2.468	2.683 ± 2.498	27.232 ± 3.252
	2/14	1.413 ± 2.057	0.108 ± 2.028	0.411 ± 2.035	15.429 ± 2.616
	3/8	1.510 ± 2.176	-0.255 ± 2.050	2.342 ± 2.157	17.871 ± 2.727
	4/17	—(a)	—(a)	—(a)	1.395 ± 1.491
Gross alpha (Bq/L)	1/11	0.186 ± 0.093	0.570 ± 0.250	0.685 ± 0.283	0.075 ± 0.037
	2/14	0.040 ± 0.036	0.222 ± 0.100	0.033 ± 0.019	0.060 ± 0.032
	3/8	0.094 ± 0.077	0.248 ± 0.141	0.043 ± 0.019	0.062 ± 0.042
Gross beta (Bq/L)	1/11	0.349 ± 0.062	0.522 ± 0.115	0.736 ± 0.130	0.198 ± 0.032
	2/14	0.278 ± 0.056	0.336 ± 0.081	0.099 ± 0.021	0.251 ± 0.048
	3/8	0.270 ± 0.075	0.259 ± 0.095	0.091 ± 0.019	0.202 ± 0.039



Table 7-1. Tritium, gross alpha, and gross beta in storm water runoff at the Livermore site, 2000 (concluded)

Parameter	Date	Drainage Retention Basin		
		Site influent		Site effluent
		CDB	CDB2	CDBX
Tritium (Bq/L)	1/11	—(a)	—(a)	—(a)
	2/14	5.328 ± 2.213	0.914 ± 2.039	9.546 ± 2.394
	3/8	2.242 ± 2.153	11.285 ± 2.520	7.918 ± 2.390
	4/17	—(a)	—(a)	—(a)
Gross alpha (Bq/L)	1/11	—(a)	—(a)	—(a)
	2/14	—(a)	—(a)	—(a)
	3/8	0.051 ± 0.029	0.021 ± 0.047	0.043 ± 0.041
Gross beta (Bq/L)	1/11	—(a)	—(a)	—(a)
	2/14	—(a)	—(a)	—(a)
	3/8	0.163 ± 0.027	0.251 ± 0.067	0.159 ± 0.039

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See main volume, Chapter 14.

a Sample was not collected because there was no flow.

**Table 7-2. Special tritium source investigation sampling in storm water runoff (Bq/L) at the Livermore site, 1999–2000**

Location	Storm date	Tritium (Bq/L)	Location	Storm date	Tritium (Bq/L)
L-191E-RO	2/8/99	309.69 ± 8.36	L-3RDR-RO	9/22/00	-2.49 ± 4.07
	4/8/99	31.89 ± 3.45		4/17/00	1.92 ± 1.51
L-191S-RO	2/8/99	49.21 ± 4.03	L-3RDS-RO	2/14/00	16761.00 ± 54.39
	4/8/99	2.28 ± 2.41		3/8/00	9176.00 ± 40.33
L-196E-RO	1/20/99	13.17 ± 2.34	L-3RDW-RO	4/17/00	47138.00 ± 114.11
	2/8/99	96.94 ± 4.37		4/17/00	99.53 ± 4.29
	4/8/99	24.20 ± 3.41	L-494E-RO	1/20/99	23.16 ± 2.68
L-196S-RO	1/20/99	4.70 ± 2.02	L-494S-RO	2/8/99	43.29 ± 3.85
	2/8/99	5.62 ± 1.88		4/8/99	5.33 ± 2.72
	4/8/99	7.55 ± 2.83	L-591E-RO	1/20/99	23.31 ± 2.68
L-231A-RO	4/14/00	2.38 ± 2.14		2/8/99	33.74 ± 3.57
L-231B-RO	4/14/00	1.32 ± 2.09		4/8/99	17.98 ± 3.18
L-231C-RO	4/14/00	2.24 ± 2.13	L-591S-RO	2/8/99	18.28 ± 3.12
L-231D-RO	4/14/00	0.41 ± 2.06		4/8/99	2.87 ± 2.43
L-231E-RO	4/14/00	0.01 ± 2.04	L-AVED-RO	2/8/99	36.52 ± 3.66
L-2582-RO	4/8/99	15.39 ± 2.91		4/8/99	8.03 ± 2.83
L-298E-RO	11/8/99	7215.00 ± 37.74	L-B4PIC-RO	4/17/00	1.71 ± 1.50
	1/11/00	1557.70 ± 16.87		5/16/00	858.40 ± 12.65
	2/14/00	219.04 ± 6.55	L-B4PK-RO	9/22/00	0.77 ± 4.07
	3/8/00	3774.00 ± 26.20	L-C4PIC-RO	4/17/00	28860.00 ± 68.82
	4/17/00	16835.00 ± 52.54		4/17/00	39220.00 ± 79.55
	4/8/99	4.96 ± 2.52	L-C4PK-RO	9/22/00	0.08 ± 4.07
	11/8/99	12.36 ± 2.64	L-H138-RO	2/14/00	19.24 ± 2.71
	1/11/00	1.78 ± 2.47	L-H139-RO	3/8/00	27.42 ± 3.25
	2/14/00	6.59 ± 2.26		2/14/00	4.03 ± 2.16
L-298S-RO	3/8/00	3.77 ± 2.50		3/8/00	3.11 ± 2.48
	4/17/00	1.26 ± 1.49	L-H161-RO	2/14/00	12.36 ± 2.48
	4/8/99	237.17 ± 7.33	L-H566-RO	3/8/00	21.57 ± 3.09
	11/8/99	414.40 ± 9.32		2/14/00	8.66 ± 2.36
	1/11/00	208.68 ± 6.59	L-H616-RO	3/8/00	41.07 ± 3.59
	2/14/00	331.15 ± 7.99		2/14/00	1.26 ± 2.08
	3/8/00	425.55 ± 9.07	L-T49E-RO	1/20/99	21.68 ± 2.66
L-341N-RO	4/17/00	122.10 ± 4.66	L-T49S-RO	2/8/99	71.04 ± 4.55
	9/22/00	5.29 ± 4.44		4/8/99	5.14 ± 2.53
L-341W-RO	9/22/00	6.18 ± 4.07	L-WPDS-RO	1/20/99	8.73 ± 2.19
L-343N-RO	9/22/00	11988.00 ± 1184.00		2/8/99	36.52 ± 3.67
	10/26/00	202.39 ± 23.31	L-WPDW-RO	4/8/99	4.18 ± 2.49
L-3726-RO	4/8/99	510.60 ± 10.40		1/20/99	12.40 ± 2.29
	11/8/99	1779.70 ± 19.06		2/8/99	85.47 ± 4.14
	1/11/00	425.50 ± 9.03		4/8/99	25.64 ± 3.44
	2/14/00	4847.00 ± 29.60		1/20/99	1.18 ± 1.91
	3/8/00	592.00 ± 10.55		2/8/99	16.72 ± 2.33
	4/17/00	3348.50 ± 23.42		4/8/99	1.14 ± 2.35
	9/22/00	0.93 ± 4.07			
L-3RDE-RO	2/14/00	331.89 ± 7.92			
	3/8/00	791.80 ± 12.14			
	4/17/00	2419.80 ± 19.91			

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See main volume, Chapter 14.

**Table 7-3. Plutonium in storm water runoff, Livermore site, 2000**

Parameter	Date sampled	Arroyo Seco effluent	
		ASW	
		Water samples ($\mu\text{Bq/L}$)	Sediments ($\mu\text{Bq/g}$)
Plutonium-238	1/11	<32.4 ± 61.6	<31.7 ± 1561.9
	2/14	<16.9 ± 153.6	<45.3 ± 124.7
	3/8	<2.2 ± 90.9	<1428.4 ± 4303.6
Plutonium-239+240	1/11	<70.7 ± 0	<1331.9 ± 2018.2
	2/14	<74.9 ± 107.2	<45.3 ± 129.9
	3/8	<87.9 ± 0	1072.2 ± 3205.4

Parameter	Date sampled	Arroyo Las Positas effluent	
		WPDC	
		Water samples ($\mu\text{Bq/L}$)	Sediments ($\mu\text{Bq/g}$)
Plutonium-238	1/11	<23.6 ± 134.3	<411.8 ± 949.8
	2/14	<21.2 ± 90.9	<-964.6 ± 1836.5
	3/8	<23.6 ± 92.4	<-545.4 ± 3821.3
Plutonium-239+240	1/11	<11.8 ± 95.0	<214.8 ± 430.4
	2/14	<76.1 ± 0	<374.7 ± 1391.3
	3/8	<64.2 ± 52.7	<3591.3 ± 0

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See main volume, Chapter 14.



Table 7-4. Metals detected in storm water runoff, Livermore site, 2000

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin		
			Site influent	Site effluent	Site influent			Site effluent	DRB influent		DRB effluent
					ASS2	ASW	ALPE	ALPO	GRNE	WPDC	
Aluminum	NPDESDISS	1/11	<0.05	0.06	0.092	<0.05	0.09	0.11	—(a)	—(a)	—(a)
	GEN/MINTOT	2/14	21	28	3.2	5.4	3.2	2.6	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	25	28	6.3	6	2.9	2.7	—(a)	—(a)	—(a)
	GEN/MINDISS	3/8	<0.05	<0.05	<0.05	<0.05	0.1	0.2	0.2	0.1	0.1
	NPDESDISS	3/8	<0.05	<0.05	0.2	<0.05	<0.05	0.2	0.4	0.3	0.3
Arsenic	NPDESDISS	1/11	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.01	0.011	0.002	0.012	0.002	0.004	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	0.002	<0.002
Barium	NPDESDISS	1/11	<0.025	<0.025	0.048	<0.025	0.046	0.03	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.38	0.44	0.14	0.15	0.1	0.092	—(a)	—(a)	—(a)
	NPDESDISS	3/8	0.075	0.056	0.069	0.1	0.05	0.056	0.03	0.074	0.082
Beryllium	NPDESDISS	1/11	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.0007	0.0009	<0.0002	<0.0002	<0.0002	<0.0002	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Boron	NPDESDISS	1/11	<0.05	<0.05	2.7	3.6	0.2	0.19	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.81	0.84	3.1	4.6	1.1	1.7	—(a)	—(a)	—(a)
	NPDESDISS	3/8	1.3	0.84	7.4	6.3	0.21	0.98	<0.05	7.2	2.4
Calcium	GEN/MINTOT	2/14	39	45	28	78	18	29	—(a)	—(a)	—(a)
	GEN/MINDISS	3/8	54	37	52	140	13	26	5.6	49	32
	NPDESDISS	1/11	<0.001	0.001	<0.001	<0.001	<0.001	0.002	—(a)	—(a)	—(a)
Chromium	NPDESMETAL	2/14	0.052	0.065	0.016	0.0092	0.005	0.0072	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.001	<0.001	<0.001	<0.001	0.001	0.003	0.004	0.001	0.003
	NPDESDISS	1/11	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	—(a)	—(a)	—(a)
Cobalt	NPDESDISS	2/14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	—(a)	—(a)	—(a)
	NPDESMETAL	3/8	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	—(a)	—(a)	—(a)
	NPDESDISS	1/11	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	NPDESDISS	2/14	0.0068	0.013	0.0057	0.005	0.003	0.0086	—(a)	—(a)	—(a)
	GEN/MINTOT	3/8	0.05	0.058	<0.01	0.02	<0.01	<0.01	—(a)	—(a)	—(a)
	NPDESMETAL	1/11	0.033	0.039	0.011	0.016	0.0063	0.0066	—(a)	—(a)	—(a)
Chromium(VI)	GEN/MINDISS	2/14	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	NPDESDISS	3/8	0.004	0.005	0.004	0.004	0.005	0.002	0.004	0.004	0.005
	NPDESDISS	1/11	0.002	0.0059	0.01	0.014	0.013	0.011	—(a)	—(a)	—(a)
Iron	NPDESDISS	2/14	0.015	0.017	0.026	0.01	0.017	0.0097	—(a)	—(a)	—(a)
	NPDESMETAL	3/8	0.003	0.004	0.01	0.005	0.003	0.0071	0.0065	0.0071	0.0054
	NPDESDISS	1/11	0.052	0.085	0.084	<0.05	<0.05	0.1	—(a)	—(a)	—(a)
Iron	GEN/MINTOT	2/14	26	34	2.5	4.8	2.5	2.1	—(a)	—(a)	—(a)
	NPDESMETAL	3/8	<0.05	<0.05	0.09	<0.05	0.18	0.16	0.29	0.18	0.2
	NPDESDISS	1/11	<0.05	0.063	0.18	0.078	0.078	0.2	0.26	0.25	0.23

**Table 7-4. Metals detected in storm water runoff, Livermore site, 2000 (concluded)**

Parameter (mg/L)	Requested analysis	Storm date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin			
			Site influent	Site effluent	Site influent			Site effluent	DRB influent		DRB effluent	
					ASS2	ASW	ALPE	ALPO	GRNE	WPDC	CDB	
Lead	NPDESDISS	1/11	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.012	0.016	<0.005	<0.005	<0.005	<0.005	<0.005	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	GENMINTOT	2/14	25	30	13	25	5.5	12	—(a)	—(a)	—(a)	—(a)
	GENMINDISS	3/8	31	21	25	46	4	9.9	1.6	23	14	—(a)
Manganese	NPDESDISS	1/11	0.018	0.034	0.016	<0.01	<0.01	0.02	—(a)	—(a)	—(a)	—(a)
	GENMINTOT	2/14	0.56	0.74	0.092	0.17	0.056	0.43	—(a)	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.58	0.73	0.17	0.17	0.037	0.044	—(a)	—(a)	—(a)	—(a)
	GENMINDISS	3/8	0.025	0.015	0.016	0.019	<0.01	<0.01	<0.01	0.024	0.024	<0.01
	NPDESDISS	3/8	0.028	0.016	0.018	0.019	<0.01	<0.01	<0.01	0.027	0.027	<0.01
Nickel	NPDESDISS	1/11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	—(a)	—(a)	—(a)	—(a)
	GENMINTOT	2/14	0.058	0.082	<0.05	<0.05	<0.05	<0.05	<0.05	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.06	0.08	0.022	0.01	0.008	0.007	—(a)	—(a)	—(a)	—(a)
	GENMINDISS	3/8	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	NPDESDISS	3/8	0.004	0.007	0.009	0.005	0.003	0.004	0.002	0.008	0.008	0.005
Selenium	NPDESDISS	1/11	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	—(a)	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	—(a)	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	NPDESDISS	1/11	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	—(a)	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	—(a)	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sodium	GENMINTOT	2/14	56	65	100	170	27	68	—(a)	—(a)	—(a)	—(a)
	GENMINDISS	3/8	100	67	240	280	16	50	4	220	89	—(a)
Thallium	NPDESDISS	1/11	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	—(a)	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	—(a)	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	NPDESDISS	1/11	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	—(a)	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.053	0.071	0.02	0.02	0.01	0.01	—(a)	—(a)	—(a)	—(a)
	NPDESDISS	3/8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	NPDESDISS	1/11	0.082	0.084	<0.02	<0.02	<0.02	0.071	—(a)	—(a)	—(a)	—(a)
	GENMINTOT	2/14	0.11	0.15	<0.05	0.093	0.056	0.09	—(a)	—(a)	—(a)	—(a)
	NPDESMETAL	2/14	0.11	0.16	0.043	0.038	0.07	0.082	—(a)	—(a)	—(a)	—(a)
	GENMINDISS	3/8	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.057	<0.05	<0.05	<0.05
	NPDESDISS	3/8	0.032	0.023	<0.02	<0.02	0.034	0.045	0.088	0.048	0.025	—(a)

a Sample was not collected because there was no flow.



Table 7-5. Nonradioactive constituents (other than metals) detected in storm water runoff, Livermore site, 2000

Parameter	Storm date	Arroyo Seco		Arroyo Las Positas				Drainage Retention Basin		
		Site influent	Site effluent	Site influent			Site effluent	Site influent		Site effluent
				ASS2	ASW	ALPE		WPDC	CDB	
Physical (mg/L)										
Chemical oxygen demand	2/14	130	144	103	64	64	55	—(a)	—(a)	—(a)
Total suspended solids (TSS)	1/11	19	56	114	397	603	98	—(a)	—(a)	—(a)
	2/14	740	835	36	122	51.8	33	—(a)	—(a)	—(a)
	3/8	20	29	43.7	50.5	26.2	61	69.3	65	16
Anions (mg/L)										
Bromide	2/14	0.1	0.1	0.3	0.9	0.1	0.2	—(a)	—(a)	—(a)
	3/8	0.3	0.2	0.6	2	0.1	0.2	<0.1	0.5	0.3
Chloride	2/14	57	57	95	203	13	69	—(a)	—(a)	—(a)
	3/8	96	57	224	357	6.2	52	3.2	172	94
Fluoride	2/14	0.19	0.21	0.24	0.7	0.14	0.2	—(a)	—(a)	—(a)
	3/8	0.3	0.2	0.56	1.3	0.13	0.19	<0.05	0.44	0.23
Nitrate (as N)	2/14	2.2	2.3	0.31	2.9	1.7	1	—(a)	—(a)	—(a)
	3/8	1.2	0.92	<0.1	3.1	3.3	1.5	0.42	0.17	0.98
Nitrate (as NO ₃)	2/14	9.8	10	1.4	13	7.6	4.6	—(a)	—(a)	—(a)
	3/8	5.1	4.1	<0.4	14	14	6.5	1.8	0.77	4.3
Nitrite (as N)	2/14	0.048	0.048	0.028	0.061	0.02	0.028	—(a)	—(a)	—(a)
	3/8	<0.02	<0.02	<0.02	0.02	<0.02	0.02	0.02	<0.02	<0.02
Nitrite (as NO ₂)	2/14	0.16	0.16	0.093	0.2	0.07	0.093	—(a)	—(a)	—(a)
	3/8	<0.07	<0.07	<0.07	0.07	<0.07	0.07	0.07	<0.07	<0.07
Orthophosphate	2/14	2.3	2.3	2.81	1.9	1.2	1.33	—(a)	—(a)	—(a)
	3/8	0.559	0.46	1.4	0.612	0.41	0.35	0.23	1.16	0.913
Sulfate	2/14	77	86	88	212	3	53	—(a)	—(a)	—(a)
	3/8	164	98	244	434	6.4	41	2.2	185	69
Alkalinity (mg/L)										
Bicarbonate alkalinity (as CaCO ₃)	2/14	133	133	120	186	90	114	—(a)	—(a)	—(a)
Carbonate alkalinity (as CaCO ₃)	2/14	<5	<5	<5	7.1	<5	<5	—(a)	—(a)	—(a)
Total alkalinity (as CaCO ₃)	2/14	133	133	120	193	90	114	—(a)	—(a)	—(a)
Herbicides (µg/L)										
Bromacil	2/14	1.2	<1	<0.5	14	100	10	—(a)	—(a)	—(a)
	3/8	0.5	<0.5	0.56	3.8	180	3.1	0.53	1.1	<0.5
Diuron	2/14	<1	2.6	2.1	23	22	3.3	—(a)	—(a)	—(a)
	3/8	<1	<1	<1	1.2	24	<1	<1	<1	<1
Glyphosate	3/8	<9	15	<9	<9	25	12	12	<9	11
Simazine	2/14	<1	<1	<0.5	<0.5	<0.5	<0.5	—(a)	—(a)	—(a)
	3/8	<0.5	<0.5	<0.5	<0.5	0.52	<0.5	<0.5	<0.5	<0.5
Miscellaneous organics (mg/L)										
Oil and grease	2/14	<1	<1	<1	<1	<1	<1	—(a)	—(a)	—(a)
	3/8	<1	1.2	1.8	2.2	<1	1.8	1.2	<1	<1
Total organic carbon (TOC)	2/14	18	18	23	14	18	12	—(a)	—(a)	—(a)
	3/8	9.4	8.2	27	11	4.2	6	5.7	18	13

a Sample was not collected because there was no flow.

**Table 7-6. Number of nondetections in storm water runoff, Livermore site, 2000**

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Anions (mg/L)			
Bromide	1	15	<0.1
Fluoride	1	15	<0.05
Nitrate (as N)	1	15	<0.1
Nitrate (as NO ₃)	1	15	<0.4
Nitrite (as N)	5	15	<0.02
Nitrite (as NO ₂)	6	15	<0.07
Wet chemistry (mg/L)			
Carbonate alkalinity (as CaCO ₃)	5	6	<5
Hydroxide alkalinity (as CaCO ₃)	6	6	<5
Herbicides (µg/L)			
Alachlor	15	15	<1
Atraton	15	15	<1
Atrazine	15	15	<1
Bromacil	3	15	<1
Butachlor	15	15	<1
Diazinon	15	15	<1
Dimethoate	15	15	<1
Diuron	8	15	<1
Glyphosate	4	9	<9
Metolachlor	15	15	<1
Metribuzin	15	15	<1
Molinate	15	15	<1
Prometon	15	15	<1
Prometryn	15	15	<1
Simazine	14	15	<1
Terbutryn	15	15	<1
Volatile organic compounds (µg/L)			
1,1,1-Trichloroethane	1	1	<0.5
1,1,2,2-Tetrachloroethane	1	1	<0.5
1,1,2-Trichloroethane	1	1	<0.5
1,1-Dichloroethane	1	1	<0.5
1,1-Dichloroethene	1	1	<0.5
1,2-Dichlorobenzene	1	1	<0.5
1,2-Dichloroethane	1	1	<0.5
1,2-Dichloroethene (total)	1	1	<1
1,2-Dichloropropane	1	1	<0.5

**Table 7-6. Number of nondetections in storm water runoff, Livermore site, 2000
(continued)**

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Volatile organic compounds (µg/L) (continued)			
1,3-Dichlorobenzene	1	1	<0.5
1,4-Dichlorobenzene	1	1	<0.5
Bromodichloromethane	1	1	<0.5
Bromoform	1	1	<0.5
Bromomethane	1	1	<0.5
Carbon tetrachloride	1	1	<0.5
Chlorobenzene	1	1	<0.5
Chloroethane	1	1	<1
Chloroform	1	1	<0.5
Chloromethane	1	1	<1
cis-1,2-Dichloroethene	1	1	<0.5
cis-1,3-Dichloropropene	1	1	<0.5
Dibromochloromethane	1	1	<0.5
Dichlorodifluoromethane	1	1	<0.5
Freon 113	1	1	<0.5
Methylene chloride	1	1	<1
Tetrachloroethene	1	1	<0.5
Total Trihalomethanes	1	1	<2
trans-1,2-Dichloroethene	1	1	<0.5
trans-1,3-Dichloropropene	1	1	<0.5
Trichloroethene	1	1	<0.5
Trichlorofluoromethane	1	1	<0.5
Vinyl chloride	1	1	<0.5
Pesticides (ug/L)			
PCB 1016	5	5	<0.2
PCB 1221	5	5	<0.2
PCB 1232	5	5	<0.2
PCB 1242	5	5	<0.2
PCB 1248	5	5	<0.2
PCB 1254	5	5	<0.2
PCB 1260	5	5	<0.2
Total PCBs	5	5	<0.2



**Table 7-6. Number of nondetections in storm water runoff, Livermore site, 2000
(concluded)**

Parameter	Number of nondetects (total analyses)	Number of samples taken	Highest reported detection limit
Metals (mg/L)			
Aluminum	10	36	<0.05
Antimony	21	21	<0.004
Arsenic	12	21	<0.002
Barium	3	21	<0.025
Beryllium	19	21	<0.0002
Boron	3	21	<0.05
Cadmium	21	21	<0.001
Carbonate alkalinity (as CaCO ₃)	10	15	<5
Chromium	8	21	<0.001
Cobalt	21	21	<0.05
Copper	13	36	<0.01
Fluoride	1	15	<0.05
Chromium(VI)	6	6	<0.01
Hydroxide alkalinity (as CaCO ₃)	15	15	<5
Iron	6	36	<0.05
Lead	19	21	<0.005
Manganese	10	36	<0.01
Mercury	21	21	<0.0004
Molybdenum	21	21	<0.025
Nickel	19	36	<0.05
Nitrite (as N)	4	15	<0.02
Selenium	21	21	<0.002
Surfactants	11	15	<1
Thallium	21	21	<0.001
Vanadium	13	21	<0.01
Zinc	14	36	<0.05
Miscellaneous (mg/L)			
Oil and grease	10	15	<1



Table 7-7. Radioactivity in storm water runoff, Site 300, 2000

Parameter (Bq/L)	Sampling date	Upstream location	Effluent locations			Downstream location
			CARW	N883	NLIN	
Gross alpha	1/24	—(a)		0.085 ± 0.043	—(a)	0.049 ± 0.030
	2/14	1.306 ± 0.422		—(a)	0.364 ± 0.109	—(a)
	2/22	—(a)		—(a)	—(a)	0.115 ± 0.050
	3/2	—(a)	0.029 ± 0.022	—(a)	—(a)	—(a)
Gross beta	1/24	—(a)		0.318 ± 0.051	—(a)	0.150 ± 0.026
	2/14	1.950 ± 0.326		—(a)	0.548 ± 0.089	—(a)
	2/22	—(a)		—(a)	—(a)	0.291 ± 0.045
	3/2	—(a)	0.152 ± 0.025	—(a)	—(a)	—(a)
Tritium	1/24	—(a)	—1.003 ± 1.299	—(a)	—	0.140 ± 1.376
	2/14	—0.361 ± 2.017	—(a)	—	1.376 ± 2.087	—(a)
	2/22	—(a)	—(a)	—(a)	—	—0.466 ± 1.980
	3/2	—(a)	0.962 ± 1.506	—(a)	—(a)	—(a)
Uranium 234+233	1/24	—(a)	0.005 ± 0.003	—(a)	—	0.004 ± 0.002
	2/14	0.064 ± 0.013	—(a)	—	0.077 ± 0.014	—(a)
	2/22	—(a)	—(a)	—(a)	—	0.011 ± 0.003
	3/2	—(a)	0.002 ± 0.002	—(a)	—(a)	—(a)
Uranium 235+236	1/24	—(a)	0.00005 ± 0.001	—(a)	—	0.001 ± 0.001
	2/14	0.002 ± 0.002	—(a)	—	0.002 ± 0.001	—(a)
	2/22	—(a)	—(a)	—(a)	—	0.001 ± 0.001
	3/2	—(a)	0.0004 ± 0.001	—(a)	—(a)	—(a)
Uranium 238	1/24	—(a)	0.009 ± 0.003	—(a)	—	0.004 ± 0.002
	2/14	0.058 ± 0.012	—(a)	—	0.115 ± 0.020	—(a)
	2/22	—(a)	—(a)	—(a)	—	0.009 ± 0.003
	3/2	—(a)	0.002 ± 0.001	—(a)	—(a)	—(a)

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See main volume, Chapter 14.

a Sample was not collected because there was no flow.

**Table 7-8. Nonradioactive constituents in storm water runoff, Site 300, 2000**

Parameter	Sampling date	Upstream location CARW	Effluent location			Downstream location GEOCRK
			N883	NLIN	NPT76	
General minerals						
pH (pH units)	1/24	—(a)	7	—(a)	7.6	8.35
	2/14	8.21	—(a)	8.03	—(a)	8.18
	2/22	—(a)	—(a)	—(a)	8.32	—(a)
	3/2	—(a)	7.07	—(a)	—(a)	—(a)
Specific conductance ($\mu\text{S}/\text{cm}$)	1/24	—(a)	65	—(a)	181	2360
	2/14	690	—(a)	500	—(a)	978
	2/22	—(a)	—(a)	—(a)	204	—(a)
	3/2	—(a)	50	—(a)	—(a)	—(a)
Total suspended solids (TSS) (mg/L)	1/24	—(a)	443	—(a)	18	<2
	2/14	1710	—(a)	243	—(a)	1100
	2/22	—(a)	—(a)	—(a)	64	—(a)
	3/2	—(a)	66.5	—(a)	—(a)	—(a)
Miscellaneous organics						
Total organic carbon (TOC) (mg/L)	1/24	—(a)	12	—(a)	3.9	18
	2/14	12	—(a)	11	—(a)	12
	2/22	—(a)	—(a)	—(a)	5.4	—(a)
	3/2	—(a)	13	—(a)	—(a)	—(a)
Total organic halides (TOX) ($\mu\text{g}/\text{L}$)	1/24	—(a)	<20	—(a)	<20	49
	2/14	<20	—(a)	<20	—(a)	<20
	2/22	—(a)	—(a)	—(a)	<20	—(a)
	3/2	—(a)	<400	—(a)	—(a)	—(a)
Polychlorinated biphenyls ($\mu\text{g}/\text{L}$)						
PCB 1016	2/14	—(b)	—(b)	<0.2	—(b)	—(b)
PCB 1221	2/14	—(b)	—(b)	<0.2	—(b)	—(b)
PCB 1232	2/14	—(b)	—(b)	<0.2	—(b)	—(b)
PCB 1242	2/14	—(b)	—(b)	<0.2	—(b)	—(b)
PCB 1248	2/14	—(b)	—(b)	<0.2	—(b)	—(b)
PCB 1254	2/14	—(b)	—(b)	<0.2	—(b)	—(b)
PCB 1260	2/14	—(b)	—(b)	<0.2	—(b)	—(b)
Total PCBs	2/14	—(b)	—(b)	<0.2	—(b)	—(b)

a Sample was not collected because there was no flow.

b Analyses not performed on water samples from this location

**Table 7-9. Dioxins in storm water runoff, sampling location NLIN, Site 300,
February 14, 2000**

Constituents ^(a)	Results (pg/L)
1,2,3,4,6,7,8-HpCDD	49
1,2,3,4,6,7,8-HpCDF	15
1,2,3,4,6,7,8-OCDD	470
1,2,3,4,6,7,8-OCDF	86
1,2,3,4,7,8,9-HpCDF	<1
1,2,3,4,7,8-HxCDD	<2.5
1,2,3,4,7,8-HxCDF	<1.1
1,2,3,6,7,8-HxCDD	<2.4
1,2,3,6,7,8-HxCDF	<1.1
1,2,3,7,8,9-HxCDD	<2.3
1,2,3,7,8,9-HxCDF	<0.7
1,2,3,7,8-PeCDD	<1.9
1,2,3,7,8-PeCDF	<2.6
2,3,4,6,7,8-HxCDF	<0.94
2,3,4,7,8-PeCDF	<2.3
2,3,7,8-TCDD	<2.7
2,3,7,8-TCDF	<1.4
Total Heptachlorinated dibenzo-furans (HpCDF)	43
Total Heptachlorinated dibenzo-p-dioxins (HpCDD)	78
Total Hexachlorinated dibenzo-furans (HxCDF)	7.5
Total Hexachlorinated dibenzo-p-dioxins (HxCDD)	2.5
Total Pentachlorinated dibenzo-furans (PeCDF)	<2.6
Total Pentachlorinated dibenzo-p-dioxins (PeCDD)	<1.9
Total Tetrachlorinated dibenzo-furans (TCDF)	<1.4
Total Tetrachlorinated dibenzo-p-dioxins (TCDD)	<2.7

a The complete chemical names for these abbreviated isomers are spelled out at the bottom of the table.

**Table 7-10. Tritium in rain (Bq/L), Livermore site, Livermore Valley, and Site 300, 2000**

	1/26	2/24	3/23	4/20	5/18	9/22	10/12
Location	Livermore site						
B343	50.0 ± 3.81	70.7 ± 4.11	1410 ± 15.2	191 ± 6.18	437 ± 8.62	1.89 ± 1.65	17.9 ± 3.26
B291	0.85 ± 2.45	3.70 ± 2.49	8.07 ± 1.82	3.85 ± 1.65	—(a)	-0.01 ± 1.57	2.89 ± 2.33
CDB	4.18 ± 2.57	6.44 ± 2.56	58.5 ± 4.03	3.06 ± 1.61	39.2 ± 2.92	-0.66 ± 1.53	10.8 ± 2.74
VIS	2.19 ± 2.49	1.79 ± 2.41	8.18 ± 1.82	3.85 ± 1.65	—(a)	-0.16 ± 1.58	4.48 ± 2.33
COW	1.06 ± 2.47	2.79 ± 2.44	11.6 ± 1.96	0.27 ± 1.47	—(a)	-1.33 ± 1.52	3.81 ± 2.44
SALV	-1.29 ± 2.37	2.72 ± 2.44	6.81 ± 1.76	2.70 ± 1.59	—(a)	13.1 ± 2.15	0.78 ± 2.33
MET	-0.03 ± 2.41	1.65 ± 2.05	—(b)	62.2 ± 3.89	—(a)	-1.10 ± 1.51	0.34 ± 2.29
	Livermore Valley						
ESAN	1.44 ± 1.48	1.54 ± 2.41	6.73 ± 1.75	-0.11 ± 1.44	2.04 ± 1.55	-0.14 ± 1.57	—(c)
ZON7	2.09 ± 1.51	0.62 ± 2.38	2.97 ± 1.57	5.96 ± 1.75	2.08 ± 1.54	—(b)	—(c)
SLST	-1.98 ± 2.34	-0.41 ± 2.32	0.78 ± 1.45	3.66 ± 1.64	—(a)	-1.24 ± 1.52	—(c)
GTES	0.95 ± 2.45	0.26 ± 2.36	4.85 ± 1.68	-0.50 ± 1.42	—(a)	-0.84 ± 1.51	—(c)
VINE	-0.88 ± 2.38	0.24 ± 2.35	1.92 ± 1.52	-0.04 ± 1.44	—(a)	-2.11 ± 1.44	—(c)
BVA	-0.06 ± 2.42	2.09 ± 2.42	-0.10 ± 1.40	-0.13 ± 1.44	—(a)	-0.87 ± 1.51	—(c)
VET	-0.18 ± 2.43	-0.41 ± 2.34	4.33 ± 1.64	0.78 ± 1.49	—(a)	-0.71 ± 1.51	—(c)
PATT	-0.40 ± 2.42	0.59 ± 2.36	0.66 ± 1.45	5.96 ± 1.75	—(a)	—(b)	—(c)
AMON	-0.37 ± 2.41	-0.07 ± 2.35	4.51 ± 1.66	1.80 ± 1.55	—(a)	—(b)	—(c)
	Site 300						
COMP	-0.45 ± 1.36	0.22 ± 1.99	0.14 ± 2.38	-1.64 ± 1.97	—(a)	—(b)	—(c)
PRIM	0.01 ± 1.40	0.01 ± 1.98	—(b)	-0.57 ± 2.01	—(a)	—(b)	—(c)
TNK5	0.00 ± 1.40	-0.13 ± 1.98	—(b)	-0.63 ± 1.99	—(a)	—(b)	—(c)

Note: Radioactivity is reported with an uncertainty ($\pm 2\sigma$ counting error). If the radioactivity is less than or equal to the uncertainty, the result is considered to be a nondetection. Negative radioactivity can result when the background correction is subtracted from a sample measurement. The measurements shown have all been corrected for background activity.

a Special study, only downwind locations sampled

b Collected volume was below the minimum needed for analysis.

c Special study, only on-site locations sampled

**Table 7-11. Drainage Retention Basin discharge limits for CDBX, identified in CERCLA Record of Decision as amended, and sampling frequencies for CDBX and WPDC**

Parameter	CDBX	WPDC	Effluent discharge limits	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Physical				
Specific conductance ($\mu\text{S}/\text{cm}$)	A	A	Not applicable	Not applicable
pH (units)	A & B	A & B	6.5–8.5	6.5–8.5
Total suspended solids (mg/L)	A & B	A & B	Not applicable	Not applicable
Total dissolved solids (mg/L)	A	A	Not applicable	Not applicable
Toxicity				
Acute aquatic survival bioassay (% survival/96 hours)	A & B	A & B	Median of 90% survival and a 90 percentile value of not less than 70% survival for 96-hour bioassay	Median of 90% survival and a 90 percentile value of not less than 70% survival for 96-hour bioassay
Chronic bioassay Fathead minnow	A	—(a)	Not applicable	Not applicable
Water flea	A	—(a)	Not applicable	Not applicable
Algae	A	—(a)	Not applicable	Not applicable
General minerals (mg/L)				
Total alkalinity	A	—(a)	Not applicable	Not applicable
Nitrate (as N)	A	—(a)	Not applicable	Not applicable
Nitrite (as N)	A	—(a)	Not applicable	Not applicable
Metals ($\mu\text{g}/\text{L}$)				
Antimony	A & B	A & B	6	Not applicable ^(b)
Arsenic	A & B	A & B	50	10
Beryllium	A & B	A & B	4	Not applicable ^(b)
Boron	A & B	A & B	Not applicable ^(c)	Not applicable ^(b)
Cadmium	A & B	A & B	5	2.2
Chromium (total)	A & B	A & B	50	Not applicable ^(b)
Chromium(VI)	A & B	A & B	Not applicable ^(c)	22
Copper	A & B	A & B	1300	23.6
Iron	A & B	A & B	Not applicable ^(c)	Not applicable ^(b)
Lead	A & B	A & B	15	6.4
Manganese	A & B	A & B	Not applicable ^(c)	Not applicable ^(b)
Mercury	A & B	A & B	2	2
Nickel	A & B	A & B	100	320
Selenium	A & B	A & B	50	10
Silver	A & B	A & B	100	8.2
Thallium	A & B	A & B	2	Not applicable ^(b)
Zinc	A & B	A & B	Not applicable ^(c)	220

**Table 7-11. Drainage Retention Basin discharge limits for CDBX, identified in CERCLA ROD as amended, and sampling frequencies for CDBX and WPDC (concluded)**

Parameter	CDBX	WPDC	Effluent discharge limits	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Organics (µg/L)				
Herbicides (EPA 507, 547, 632)	A	—(a)	Not applicable	Not applicable
Volatile organic compounds (EPA Method 601 only)	A	—(a)	5	5
Tetrachloroethene			4	4
Vinyl chloride			2	2
Chemical oxygen demand	A	—(a)	Not applicable	Not applicable
Total organic carbon	A	—(a)	Not applicable	Not applicable
Radioactivity (Bq/L)				
Alpha	A	—(a)	0.56	0.56
Beta	A	—(a)	1.85	1.85
Tritium	A	—(a)	740	740

a There is no sampling requirement for this parameter.

b No limit is established for aquatic life protection; however, aquatic life is protected by bioassay analysis.

c No maximum containment level is established for this metal.

A = Monitoring occurs at the first DRB discharge of the wet season and at one or more additional discharges associated with storm water runoff monitoring. Toxicity testing is required only on the first release.

B = Monitoring occurs at each dry season release. For purposes of discharge sampling, the dry season is defined to occur from June 1 through September 30.

**Table 7-12. Routine water quality management action levels and monitoring plan for the Drainage Retention Basin**

Constituent	Location	Sampling frequency	Management action levels	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Physical				
Dissolved oxygen (mg/L)	CDBA, CDBC, CDBD, CDBE, CDBF, CDFJ, CDBK, CDBL	Weekly	<80% saturation and <5 mg/L	<80% saturation and <5 mg/L
Temperature (°C)	CDBA, CDBC, CDBD, CDBE, CDBF, CDFJ, CDBK, CDBL	Weekly	<15.6 and >26.7	<15.6 and >26.7
Total alkalinity (as CaCO ₃) (mg/L)	CDBE	Monthly	<50	<50
Chlorophyll-a (mg/L)	CDBE	Monthly	>10	>10
pH (pH units)	CDBE	Monthly	<6.0 and >9.0	<6.0 and >9.0
Total dissolved solids (mg/L)	CDBE	Monthly	>360	>360
Total suspended solids (mg/L)	CDBE	Monthly	Not applicable	Not applicable
Turbidity (m)	CDBE	Weekly	<0.91	<0.91
Chemical oxygen demand (mg/L)	CDBE	Quarterly	>20	>20
Oil and grease (mg/L)	CDBE	Quarterly	>15	>15
Specific conductance (µS/cm)	CDBE	Monthly	>900	>900
Nutrients (mg/L)				
Nitrate (as N)	CDBE	Monthly	>0.2	>0.2
Nitrite (as N)	CDBE	Monthly	>0.2	>0.2
Ammonia nitrogen	CDBE	Monthly	>0.1	>0.1
Phosphate (as P)	CDBE	Monthly	>0.02	>0.02
Microbiological (MPN^(a)/100 mL)				
Total coliform	CDBE	Quarterly	>5000	>5000
Fecal coliform	CDBE	Quarterly	>400	>400
Metals (µg/L)				
Antimony	CDBE	Semiannually	>6	Not applicable
Arsenic	CDBE	Semiannually	>50	>10
Beryllium	CDBE	Semiannually	>4	Not applicable
Boron	CDBE	Semiannually	Not applicable	Not applicable
Cadmium	CDBE	Semiannually	>5	>2.2
Chromium, total	CDBE	Semiannually	>50	Not applicable
Chromium(VI)	CDBE	Semiannually	Not applicable	>22
Copper	CDBE	Semiannually	>1300	>23.6
Iron	CDBE	Semiannually	Not applicable	Not applicable

**Table 7-12. Routine water quality management action levels and monitoring plan for the Drainage Retention Basin (concluded)**

Constituent	Location	Sampling frequency	Management action levels	
			Dry season Apr 1–Nov 30	Wet season Dec 1–Mar 31
Metals ($\mu\text{g/L}$) (continued)				
Lead	CDBE	Semiannually	>15	>6.4
Manganese	CDBE	Semiannually	Not applicable	Not applicable
Mercury	CDBE	Semiannually	>2	>2
Nickel	CDBE	Semiannually	>100	>320
Selenium	CDBE	Semiannually	>50	>10
Silver	CDBE	Semiannually	>100	>8.2
Thallium	CDBE	Semiannually	>2	Not applicable
Zinc	CDBE	Semiannually	Not applicable	>220
Organics ($\mu\text{g/L}$)				
Total volatile organic compounds (EPA Method 601 only)	CDBE	Semiannually	>5	>5
Tetrachloroethene	CDBE	Semiannually	>4	>4
Vinyl chloride	CDBE	Semiannually	>2	>2
Herbicides	CDBE	Semiannually	Not applicable	Not applicable
Radiological (Bq/L)				
Gross alpha	CDBE	Semiannually	>0.56	>0.56
Gross beta	CDBE	Semiannually	>1.85	>1.85
Tritium	CDBE	Semiannually	>740	>740
Toxicity				
Aquatic bioassay (% survival/96-hour) Fathead minnow	CDBE	Annually	90% survival median, 90 percentile value of not less than 70% survival	90% survival median, 90 percentile value of not less than 70% survival
Chronic bioassay Fathead minnow	CDBE	Annually	Not applicable	Not applicable
Water flea	CDBE	Annually	Not applicable	Not applicable
Algae	CDBE	Annually	Not applicable	Not applicable

a MPN = Most probable number

**Table 7-13. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2000**

Parameter	CDBX sampling dates				WPDC sampling dates			
	3/8 ^(a)	10/23	10/25	10/27	3/8 ^(a)	10/23	10/25	10/27
Biological								
Aquatic bioassay								
<i>Pimephales promelas</i> survival (percent survival)	na ^(b)	na	na	100	na	na	na	100
<i>Pimephales promelas</i> growth (toxic units)	na	na	na	<1	na	na	na	na
<i>Pimephales promelas</i> growth IC 25 ^(c)	na	na	na	>100	na	na	na	na
<i>Pimephales promelas</i> growth IC 50 ^(d)	na	na	na	>100	na	na	na	na
<i>Pimephales promelas</i> growth LOEC ^(e)	na	na	na	>100	na	na	na	na
<i>Pimephales promelas</i> growth NOEC ^(f)	na	na	na	>100	na	na	na	na
<i>Pimephales promelas</i> survival toxic units	na	na	na	<1	na	na	na	na
<i>Pimephales promelas</i> survival LC 50 ^(g)	na	na	na	>100	na	na	na	na
<i>Pimephales promelas</i> survival LOEC	na	na	na	>100	na	na	na	na
<i>Pimephales promelas</i> survival NOEC	na	na	na	>100	na	na	na	na
<i>Ceriodaphnia dubia</i> growth (toxic unit)	na	na	na	<1	na	na	na	na
<i>Ceriodaphnia dubia</i> growth IC 25	na	na	na	>100	na	na	na	na
<i>Ceriodaphnia dubia</i> growth IC 50	na	na	na	>100	na	na	na	na
<i>Ceriodaphnia dubia</i> growth LOEC	na	na	na	>100	na	na	na	na
<i>Ceriodaphnia dubia</i> growth NOEC	na	na	na	>100	na	na	na	na
<i>Ceriodaphnia dubia</i> survival (toxic units)	na	na	na	<1	na	na	na	na
<i>Ceriodaphnia dubia</i> survival LC 50	na	na	na	>100	na	na	na	na
<i>Ceriodaphnia dubia</i> survival LOEC	na	na	na	>100	na	na	na	na
<i>Ceriodaphnia dubia</i> survival NOEC	na	na	na	>100	na	na	na	na
<i>Selenastrum capricornutum</i> growth (toxic units)	na	na	na	<1	na	na	na	na
<i>Selenastrum capricornutum</i> growth IC 25	na	na	na	>100	na	na	na	na
<i>Selenastrum capricornutum</i> growth IC 50	na	na	na	>100	na	na	na	na
<i>Selenastrum capricornutum</i> growth LOEC	na	na	na	>100	na	na	na	na
<i>Selenastrum capricornutum</i> growth NOEC	na	na	na	>100	na	na	na	na
Anions (mg/L)								
Bromide	0.3	na	na	na	0.2	na	na	na
Chloride	94	na	na	na	52	na	na	na
Fluoride	0.23	na	na	na	0.19	na	na	na
Nitrate (as N)	0.98	na	na	na	1.5	na	na	na

**Table 7-13. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2000 (continued)**

Parameter	CDBX sampling dates				WPDC sampling dates			
	3/8(a)	10/23	10/25	10/27	3/8(a)	10/23	10/25	10/27
Anions (mg/L) (continued)								
Nitrate (as NO ₃)	4.3	na	na	na	6.5	na	na	na
Nitrite (as N)	<0.02	na	na	na	0.02	na	na	na
Nitrite (as NO ₂)	<0.07	na	na	na	0.07	na	na	na
Orthophosphate	0.913	na	na	na	0.35	na	na	na
Sulfate	69	na	na	na	41	na	na	na
General minerals (mg/L)								
Aluminum	0.1	0.8	na	na	0.2	0.3	na	na
Bicarbonate alkalinity (as CaCO ₃)	122	154	na	na	88	204	na	na
Calcium	32	51	na	na	26	52	na	na
Carbonate alkalinity (as CaCO ₃)	<5	48	na	na	<5	41	na	na
Chloride	92	199	na	na	52	98	na	na
Copper	<0.01	0.02	na	na	<0.01	0.01	na	na
Fluoride	0.23	0.46	na	na	0.2	0.59	na	na
Hydroxide alkalinity (as CaCO ₃)	<5	<5	na	na	<5	<5	na	na
Iron	0.2	0.86	na	na	0.16	0.18	na	na
Magnesium	14	35	na	na	9.9	22	na	na
Manganese	<0.01	0.056	na	na	<0.01	<0.01	na	na
Nickel	<0.05	<0.05	na	na	<0.05	<0.05	na	na
Nitrate (as N)	0.9	1.4	na	na	1.3	4.3	na	na
Nitrate plus nitrite (as N)	na	6.2	na	na	6	19	na	na
Nitrate (as NO ₃)	4	1.4	na	na	na	4.3	na	na
Nitrite (as N)	0.02	0.02	na	na	0.039	<0.02	na	na
Orthophosphate	0.895	<0.05	na	na	0.35	0.1	na	na
pH (pH units)	8.06	8.8	8.82	na	7.91	8.62	8.48	na
Potassium	3.3	2.4	na	na	2	1.8	na	na
Sodium	89	120	na	na	50	110	na	na
Specific conductance (μS/cm)	646	1170	na	na	432	915	na	na
Sulfate	68	67	na	na	42	45	na	na
Surfactants	0.3	<0.5	na	na	<0.25	<0.5	na	na
Total alkalinity (as CaCO ₃)	122	202	na	na	88	245	na	na
Total dissolved solids (TDS)	436	683	na	na	282	557	na	na
Total hardness (as CaCO ₃)	138	271	na	na	106	220	na	na
Total phosphorus (as P)	0.38	0.07	na	na	0.21	0.07	na	na
Zinc	<0.05	<0.05	na	na	<0.05	<0.05	na	na

**Table 7-13. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2000 (continued)**

Parameter	CDBX sampling dates				WPDC sampling dates			
	3/8 ^(a)	10/23	10/25	10/27	3/8 ^(a)	10/23	10/25	10/27
Metals (mg/L)								
Aluminum	0.3	0.8	<0.05	0.8	0.2	na	na	na
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	na	na	na
Arsenic	<0.002	0.003	0.003	0.01	<0.002	na	na	na
Barium	0.082	0.13	0.092	0.14	0.056	na	na	na
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	na	na	na
Boron	2.4	2	1.3	1.8	0.98	na	na	na
Cadmium	<0.001	<0.0005	<0.0005	<0.0005	<0.001	na	na	na
Chromium	0.003	0.0076	0.027	0.016	0.003	na	na	na
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	na	na	na
Copper	0.005	0.008	0.003	0.003	0.002	na	na	na
Chromium(VI)	0.0054	0.004	0.02	0.014	0.0071	na	na	na
Iron	0.23	0.81	<0.05	1	0.2	na	na	na
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	na	na	na
Manganese	<0.01	0.057	<0.01	0.076	<0.01	na	na	na
Mercury	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	na	na	na
Molybdenum	<0.025	<0.025	<0.025	<0.025	<0.025	na	na	na
Nickel	0.005	<0.002	<0.002	0.003	0.004	na	na	na
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	na	na	na
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na
Vanadium	<0.01	0.01	<0.01	0.02	<0.01	na	na	na
Zinc	0.025	0.028	<0.02	0.06	0.045	na	na	na
Volatile organic compounds (µg/L)								
1,1,1-Trichloroethane	<0.5	<0.5	na	na	na	na	na	na
1,1,2,2-Tetrachloroethane	<0.5	<0.5	na	na	na	na	na	na
1,1,2-Trichloroethane	<0.5	<0.5	na	na	na	na	na	na
1,1-Dichloroethane	<0.5	<0.5	na	na	na	na	na	na
1,1-Dichloroethene	<0.5	<0.5	na	na	na	na	na	na
1,2-Dichlorobenzene	<0.5	<0.5	na	na	na	na	na	na
1,2-Dichloroethane	<0.5	<0.5	na	na	na	na	na	na
1,2-Dichloroethene (total)	<1	<1	na	na	na	na	na	na
1,2-Dichloropropane	<0.5	<0.5	na	na	na	na	na	na
1,3-Dichlorobenzene	<0.5	<0.5	na	na	na	na	na	na
1,4-Dichlorobenzene	<0.5	<0.5	na	na	na	na	na	na
Bromodichloromethane	<0.5	<0.5	na	na	na	na	na	na
Bromoform	<0.5	<0.5	na	na	na	na	na	na

**Table 7-13. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2000 (continued)**

Parameter	CDBX sampling dates				WPDC sampling dates			
	3/8(a)	10/23	10/25	10/27	3/8(a)	10/23	10/25	10/27
Volatile organic compounds (µg/L) (continued)								
Bromomethane	<0.5	<0.5	na	na	na	na	na	na
Carbon tetrachloride	<0.5	<0.5	na	na	na	na	na	na
Chlorobenzene	<0.5	<0.5	na	na	na	na	na	na
Chloroethane	<1	<1	na	na	na	na	na	na
Chloroform	<0.5	<0.5	na	na	na	na	na	na
Chloromethane	<1	<1	na	na	na	na	na	na
cis-1,2-Dichloroethene	<0.5	<0.5	na	na	na	na	na	na
cis-1,3-Dichloropropene	<0.5	<0.5	na	na	na	na	na	na
Dibromochloromethane	<0.5	<0.5	na	na	na	na	na	na
Dichlorodifluoromethane	<0.5	<0.5	na	na	na	na	na	na
Diuron	<1	<1	na	na	<1	na	na	na
Freon 113	<0.5	<0.5	na	na	na	na	na	na
Glyphosate	11	<9	na	na	12	na	na	na
Methylene chloride	<1	<1	na	na	na	na	na	na
Tetrachloroethene	<0.5	<0.5	na	na	na	na	na	na
Total trihalomethanes	<2	<2	na	na	na	na	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	na	na	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	na	na	na	na	na	na
Trichloroethene	<0.5	<0.5	na	na	na	na	na	na
Trichlorofluoromethane	<0.5	<0.5	na	na	na	na	na	na
Vinyl chloride	<0.5	<0.5	na	na	na	na	na	na
Polychlorinated biphenyls (µg/L)								
PCB 1016	<0.2	na	na	na	<0.2	na	na	na
PCB 1221	<0.2	na	na	na	<0.2	na	na	na
PCB 1232	<0.2	na	na	na	<0.2	na	na	na
PCB 1242	<0.2	na	na	na	<0.2	na	na	na
PCB 1248	<0.2	na	na	na	<0.2	na	na	na
PCB 1254	<0.2	na	na	na	<0.2	na	na	na
PCB 1260	<0.2	na	na	na	<0.2	na	na	na
Total PCBs	<0.2	na	na	na	<0.2	na	na	na
Herbicides (µg/L)								
Acenaphthylene	na	<0.1	na	na	na	na	na	na
Alachlor	<0.5	<0.2	na	na	<0.5	na	na	na
Anthracene	na	<0.1	na	na	na	na	na	na
Atraton	<0.5	<0.5	na	na	<0.5	na	na	na

**Table 7-13. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2000 (continued)**

Parameter	CDBX sampling dates				WPDC sampling dates			
	3/8(a)	10/23	10/25	10/27	3/8(a)	10/23	10/25	10/27
Herbicides (µg/L) (continued)								
Atrazine	<0.5	<0.5	na	na	<0.5	na	na	na
Benzo(a)anthracene	na	<0.3	na	na	na	na	na	na
Benzo(a)pyrene	na	<0.1	na	na	na	na	na	na
Benzo(b)fluoranthene	na	<0.3	na	na	na	na	na	na
Benzo(g,h,i)perylene	na	<0.3	na	na	na	na	na	na
Benzo(k)fluoranthene	na	<0.3	na	na	na	na	na	na
BHC, delta isomer	na	<0.2	na	na	na	na	na	na
BHC, gamma isomer (Lindane)	na	<0.1	na	na	na	na	na	na
Bromacil	<0.5	<1	na	na	3.1	na	na	na
Butachlor	<0.5	na	na	na	<0.5	na	na	na
Butylbenzylphthalate	na	<2	na	na	na	na	na	na
Chrysene	na	<0.3	na	na	na	na	na	na
Di (2-ethylhexyl) adipate	na	<1	na	na	na	na	na	na
Diazinon	<0.5	<0.2	na	na	<0.5	na	na	na
Dibenzo(a,h)anthracene	na	<0.3	na	na	na	na	na	na
Dibutylphthalate	na	<1	na	na	na	na	na	na
Diethylhexylphthalate	na	<3	na	na	na	na	na	na
Dimethoate	<0.5	<2	na	na	<0.5	na	na	na
Dimethylphthalate	na	<1	na	na	na	na	na	na
Fluorene	na	<0.1	na	na	na	na	na	na
Hexachlorobenzene	na	<0.1	na	na	na	na	na	na
Hexachlorocyclopentadiene	na	<1	na	na	na	na	na	na
Indeno(1,2,3-c,d)pyrene	na	<0.3	na	na	na	na	na	na
Methoxychlor	na	<0.5	na	na	na	na	na	na
Metolachlor	<0.5	<0.5	na	na	<0.5	na	na	na
Metribuzin	<0.5	<0.5	na	na	<0.5	na	na	na
Molinate	<0.5	<0.5	na	na	<0.5	na	na	na
Phenanthrene	na	<0.1	na	na	na	na	na	na
Prometon	<0.5	<0.5	na	na	<0.5	na	na	na
Prometryn	<0.5	<0.5	na	na	<0.5	na	na	na
Pyrene	na	<0.1	na	na	na	na	na	na
Secbumeton	na	<0.5	na	na	na	na	na	na
Simazine	<0.5	<0.5	na	na	<0.5	na	na	na
Terbutryl	<0.5	<0.5	na	na	<0.5	na	na	na
Thiobencarb	na	<0.5	na	na	na	na	na	na

**Table 7-13. Compliance monitoring data for releases from the Drainage Retention Basin, wet season, 2000 (concluded)**

Parameter	CDBX sampling dates				WPDC sampling dates			
	3/8(a)	10/23	10/25	10/27	3/8(a)	10/23	10/25	10/27
Miscellaneous organics (mg/L)								
Chemical oxygen demand	na	25	na	na	na	na	na	na
Oil and grease	<1	na	na	na	1.8	na	na	na
Total organic carbon (TOC)	13	4.7	na	na	6	na	na	na
Total suspended solids (TSS)	16	31	na	na	61	43	na	na

Parameter	Sampling dates		
	CDBX		WPDC
	3/8	10/24	3/8
Radioactivity (Bq/L)			
Gross alpha	0.042 ± 0.041	0.002 ± 0.04	1.68 ± 1.13
Gross beta	0.159 ± 0.039	0.104 ± 0.041	5.46 ± 1.06
Tritium	7.92 ± 2.4	10.1 ± 2.5	483 ± 73.7

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See main volume, Chapter 14.

- a Dissolved minerals and dissolved metals were analyzed on this date.
- b na = Not analyzed because the analysis was not required
- c IC 25 = 25% inhibition concentration; concentration at which 25% of the organisms show inhibition responses
- d IC 50 = 50% inhibition concentration: concentration at which 50% of the organisms show inhibition responses
- e LOEC = Lowest observed effect concentration
- f NOEC = No observed effect concentration
- g LC 50 = 50% lethal concentration; concentration at which 50% of the organisms die

**Table 7-14. Compliance monitoring data for releases from the Drainage Retention Basin, dry season, 2000**

Parameter	CDBX sampling dates				WPDC sampling dates			
	6/15	7/31	8/10	9/21	6/15	7/31	8/10	9/21
Biological								
Aquatic bioassay								
Pimephales promelas survival (percent survival)	95	95	85	95	100	90	95	100
General minerals (mg/L)								
pH (pH units)	8.56	8.71	9.12	9.16	8.81	8.48	8.29	8.17
Metals (mg/L)								
Aluminum	0.2	0.07	0.5	0.1	<0.05	0.8	<0.05	1.3
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	0.005	0.004	0.005	0.003	<0.002	0.01	<0.002	<0.002
Barium	0.12	0.11	0.16	0.1	0.1	0.14	0.1	0.13
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Boron	2.2	2.1	2.3	1.9	1.8	1.8	1.8	1.3
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.0079	0.0097	0.0051	0.003	0.015	0.016	0.015	0.011
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.001	0.001	0.003	0.004	<0.001	0.003	<0.001	0.005
Chromium(VI)	0.0075	0.0098	0.004	0.004	0.015	0.014	0.015	0.004
Iron	0.2	0.14	0.64	0.16	<0.05	1	<0.05	0.45
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.02
Manganese	0.046	0.012	0.11	0.081	<0.01	0.076	<0.01	0.051
Mercury	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002
Molybdenum	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Nickel	<0.002	<0.002	0.004	0.003	<0.002	0.003	<0.002	0.006
Selenium	<0.002	0.006	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.01	<0.01	0.01	<0.01	<0.01	0.02	<0.01	0.01
Zinc	<0.02	<0.02	<0.02	<0.02	<0.02	0.06	<0.02	0.076
Volatile organic compounds (µg/L)								
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	na ^(a)	na	na	na
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	na	na	na	na

**Table 7-14. Compliance monitoring data for releases from the Drainage Retention Basin, dry season, 2000 (concluded)**

Parameter	CDBX sampling dates				WPDC sampling dates			
	6/15	7/31	8/10	9/21	6/15	7/31	8/10	9/21
Volatile organic compounds (µg/L) (continued)								
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
1,2-Dichloroethene (total)	<1	<1	<1	<1	na	na	na	na
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
1,4-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Bromoform	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Bromomethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Chloroethane	<1	<1	<1	<1	na	na	na	na
Chloroform	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Chloromethane	<1	<1	<1	<1	na	na	na	na
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Diuron	na	na	na	na	na	na	na	na
Freon 113	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Glyphosate	na	na	na	na	na	na	na	na
Methylene chloride	<1	<1	<1	<1	na	na	na	na
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Total trihalomethanes	<2	<2	<2	<2	na	na	na	na
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Trichloroethene	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	na	na	na	na
Miscellaneous organics (mg/L)								
Total suspended solids (TSS)	20	36	26	19	3.3	3.2	9.2	51

a na = Not analyzed because the analysis was not required

Table 7-15. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000

Parameter	Sampling dates					
	1/13	2/23	3/14	4/12	5/11	6/15
Nutrients (mg/L)						
Ammonia nitrogen (as N)	<0.025	0.1	0.1	0.43	0.2	0.42
Nitrate (as N)	3.3	1.1	0.88	0.96	<0.2	0.69
Nitrate (as NO ₃)	15	5.1	3.9	4.3	<0.5	3.1
Nitrate plus nitrite (as N)	3.3	1.1	0.91	0.99	<0.2	0.69
Nitrite (as N)	<0.02	<0.02	0.028	0.031	<0.02	0.086
Nitrite (as NO ₂)	<0.5	<0.5	<0.5	<0.5	<0.5	0.28
Total Kjeldahl nitrogen	0.54	1.4	1.2	1.1	1.3	1.3
General minerals (mg/L)						
Aluminum	1.1	4.5	1.6	1.2	0.2	0.4
Bicarbonate alkalinity (as CaCO ₃)	211	107	136	143	125	178
Calcium	53	26	35	44	46	57
Carbonate alkalinity (as CaCO ₃)	<5	<5	<5	33	57	35
Chloride	170	81	97	126	144	185
Copper	<0.01	0.01	<0.01	<0.01	0.01	<0.01
Fluoride	0.43	0.2	0.24	0.31	0.36	0.44
Hydroxide alkalinity (as CaCO ₃)	<5	<5	<5	<5	<5	<5
Iron	0.82	2.7	1.5	1.3	0.26	0.4
Magnesium	31	13	16	21	25	32
Manganese	0.029	0.071	0.046	0.053	0.17	0.097
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	3.3	1.1	0.88	0.96	<0.1	0.69
Nitrate (as NO ₃)	15	5.1	3.9	4.3	<0.4	3.1
Nitrate plus nitrite (as N)	3.3	1.1	0.91	0.99	<0.2	0.69
Nitrite (as N)	0.03	0.02	0.028	0.031	<0.02	0.086
Orthophosphate	0.17	1.1	1.04	0.682	0.23	0.37
pH (pH units)	8.44	8.03	7.97	8.76	9	8.86
Potassium	2.2	3.3	3.4	2.9	2.6	2.6
Sodium	99	68	98	95	94	120
Specific conductance (μS/cm)	1030	590	720	820	843	1080
Sulfate	58	57	73	75	69	75
Surfactants	<0.05	<0.25	<0.25	0.3	<0.5	<0.5
Total alkalinity (as CaCO ₃)	211	107	136	176	182	213
Total dissolved solids (TDS)	667	390	483	540	537	647
Total hardness (as CaCO ₃)	260	118	153	196	218	274
Total phosphorus (as P)	0.11	0.46	0.38	0.32	0.3	0.21
Total suspended solids (TSS)	14.6	42	10	7.5	10	9.2
Total solids	687	442	520	577	563	690
Volatile solids	170	104	116	127	120	157
Volatile suspended solids	3.8	11	<2	2	6	<2
Zinc	0.062	<0.05	<0.05	<0.05	<0.05	<0.05
Miscellaneous organics (μg/L)						
Chlorophyll-a	3.5	0.9	1.4	1.3	9.4	4.3



Table 7-15. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000 (continued)

Parameter	Sampling dates				
	7/31	9/21	10/23	11/29	12/14
Nutrients (mg/L)					
Ammonia nitrogen (as N)	<0.025	<0.025	<0.025	0.06	0.05
Nitrate (as N)	0.24	<0.2	1.1	2.1	1.4
Nitrate (as NO ₃)	1	<0.5	5.1	9.1	6.2
Nitrate plus nitrite (as N)	0.24	0.1	1.2	2.1	1.4
Nitrite (as N)	<0.02	<0.02	0.036	0.02	0.026
Nitrite (as NO ₂)	<0.5	<0.5	<0.5	<0.5	<0.5
Total Kjeldahl nitrogen	0.84	1.1	0.73	0.4	0.57
General minerals (mg/L)					
Aluminum	0.3	0.1	<0.05	0.1	0.1
Bicarbonate alkalinity (as CaCO ₃)	174	157	123	167	161
Calcium	58	50	49	55	50
Carbonate alkalinity (as CaCO ₃)	37	51	50	35	33
Chloride	191	197	203	193	181
Copper	0.03	0.03	<0.01	0.01	<0.01
Fluoride	0.59	0.42	0.56	0.38	0.42
Hydroxide alkalinity (as CaCO ₃)	<5	<5	<5	<2.5	<2.5
Iron	0.42	0.13	0.078	0.2	0.11
Magnesium	35	36	35	33	31
Manganese	0.044	0.074	0.02	0.024	0.019
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	0.24	0.1	1.1	2.1	1.4
Nitrate (as NO ₃)	1	0.4	5.1	9.5	6.2
Nitrate plus nitrite (as N)	0.24	0.1	1.2	2.2	1.4
Nitrite (as N)	<0.02	<0.02	0.036	0.029	0.026
Orthophosphate	0.25	<0.05	<0.05	0.074	<0.05
pH (pH units)	8.9	9.15	8.82	8.57	8.65
Potassium	2.1	2.5	2.3	2.1	1.9
Sodium	100	130	120	110	110
Specific conductance (μS/cm)	1120	1130	1160	1080	1060
Sulfate	70	68	69	67	66
Surfactants	<0.5	<0.5	<0.5	<0.5	<0.5
Total alkalinity (as CaCO ₃)	211	208	173	202	194
Total dissolved solids (TDS)	657	693	673	650	627
Total hardness (as CaCO ₃)	289	273	266	273	252
Total phosphorus (as P)	0.14	0.06	<0.05	0.05	0.07
Total suspended solids (TSS)	8.3	14	<10	3	3.5
Total solids	697	703	686	647	633
Volatile solids	180	140	150	140	140
Volatile suspended solids	4.3	8.8	<10	<2	<2
Zinc	<0.05	0.14	<0.05	<0.05	<0.05
Miscellaneous organics (μg/L)					
Chlorophyll-a	15	42.7	2.5 ^(a)	1.1	1.8

**Table 7-15. Monthly analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000 (concluded)**

Parameter	Number of samples	Minimum	Maximum	Median	Interquartile range
Nutrients (mg/L)					
Ammonia nitrogen (as N)	11	<0.025	0.43	0.06	0.13
Nitrate (as N)	11	<0.2	3.3	0.96	0.79
Nitrate (as NO ₃)	11	<0.50	15	4.3	3.6
Nitrate plus nitrite (as N)	11	0.1	3.3	0.99	0.84
Nitrite (as N)	11	<0.02	0.09	0.02	0.01
Nitrite (as NO ₂)	11	<0.50	<0.50	<0.50	0
Total Kjeldahl nitrogen	11	0.4	1.4	1.1	0.6
General minerals (mg/L)					
Aluminum	11	<0.05	4.5	0.3	1.1
Bicarbonate alkalinity (as CaCO ₃)	11	107	211	157	40
Calcium	11	26	58	50	9
Carbonate alkalinity (as CaCO ₃)	11	5	57	35	25
Chloride	11	81	203	181	57
Copper	11	<0.01	0.03	<0.01	0.00
Fluoride	11	0.2	0.59	0.42	0.1
Hydroxide alkalinity (as CaCO ₃)	11	<2.5	<5	<5	0
Iron	11	0.078	2.7	0.4	0.9
Magnesium	11	13	36	31	11
Manganese	11	0.019	0.170	0.046	0.046
Nickel	11	0.05	0.05	0.05	0
Nitrate (as N)	11	0.1	3.3	0.96	0.79
Nitrate (as NO ₃)	11	<0.4	15	4.3	3.6
Nitrate plus nitrite (as N)	11	0.1	3.3	0.99	0.84
Nitrite (as N)	11	<0.02	0.086	0.028	0.011
Orthophosphate	11	<0.05	1.1	0.23	0.46
pH (pH units)	11	7.97	9.15	8.76	0.38
Potassium	11	1.9	3.4	2.5	0.6
Sodium	11	68	130	100	19
Specific conductance (μS/cm)	11	590	1160	1060	269
Sulfate	11	57	75	69	5
Surfactants	11	<0.05	<0.5	<0.5	0.23
Total alkalinity (as CaCO ₃)	11	107	213	194	35
Total dissolved solids (TDS)	11	390	693	647	124
Total hardness (as CaCO ₃)	11	118	289	260	66
Total phosphorus (as P)	11	<0.05	0.46	0.14	0.25
Total suspended solids (TSS)	11	3	42	10	4
Total solids	11	442	703	647	119
Volatile solids	11	104	180	140	30
Volatile suspended solids	11	<2	11	3.8	5.4
Zinc	11	<0.05	0.14	<0.05	0
Miscellaneous organics (μg/L)					
Chlorophyll-a	11	0.9	42.7	2.5	5.5

a Sampled on October 25, 2000

**Table 7-16. Quarterly analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000**

Parameter	Sampling dates			
	1/13	4/12	7/31	10/23
Biological (MPN/100 mL)				
Fecal coliform	540	2	8	29 ^(a)
Total coliform	920	540	23	170
Miscellaneous organics (mg/L)				
Chemical oxygen demand	18	43	29	22
Oil and grease	2.2	3.8	<1	<5

a Sampled on October 25, 2000

**Table 7-17. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000**

Parameter	Sampling dates		
	3/14	4/12	10/23
Aqueous bioassay			
<i>Pimephales promelas</i> acute survival (percent)	na ^(a)	100	100
<i>Pimephales promelas</i> growth (toxic units)	na	<1	<1
<i>Pimephales promelas</i> growth IC 25 ^(b)	na	>100	>100
<i>Pimephales promelas</i> growth IC 50 ^(c)	na	>100	>100
<i>Pimephales promelas</i> growth LOEC ^(d)	na	>100	>100
<i>Pimephales promelas</i> growth NOEC ^(e)	na	>100	>100
<i>Pimephales promelas</i> chronic survival (toxic units)	na	<1	<1
<i>Pimephales promelas</i> chronic survival LC 50 ^(f)	na	>100	>100
<i>Pimephales promelas</i> chronic survival LOEC	na	>100	>100
<i>Pimephales promelas</i> chronic survival NOEC	na	>100	>100
<i>Ceriodaphnia dubia</i> growth (toxic unit)	na	<1	2
<i>Ceriodaphnia dubia</i> growth IC 25	na	>100	12
<i>Ceriodaphnia dubia</i> growth IC 50	na	>100	96
<i>Ceriodaphnia dubia</i> growth LOEC	na	>100	>100
<i>Ceriodaphnia dubia</i> growth NOEC	na	>100	50
<i>Ceriodaphnia dubia</i> chronic survival (toxic units)	na	<1	<1
<i>Ceriodaphnia dubia</i> chronic survival LC 50	na	>100	>100
<i>Ceriodaphnia dubia</i> chronic survival LOEC	na	>100	>100
<i>Ceriodaphnia dubia</i> chronic survival NOEC	na	>100	>100
<i>Selenastrum capricornutum</i> growth (toxic units)	na	2	<1
<i>Selenastrum capricornutum</i> growth IC 25	na	52	>100
<i>Selenastrum capricornutum</i> growth IC 50	na	76	>100
<i>Selenastrum capricornutum</i> growth LOEC	na	100	>100
<i>Selenastrum capricornutum</i> growth NOEC	na	50	>100
Total metals (mg/L)			
Aluminum	1.7	1.2	0.05
Antimony	<0.004	<0.004	<0.004
Arsenic	0.003	<0.002	0.002
Barium	0.091	<0.25	0.11
Beryllium	<0.0002	<0.0002	<0.0002
Boron	3.4	2.4	1.9
Cadmium	<0.0005	<0.0005	<0.0005
Chromium	0.0074	0.0066	0.004
Chromium(VI)	0.0052	0.004	0.005
Cobalt	<0.05	<0.05	<0.05
Copper	0.007	0.007	0.008



Table 7-17. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000 (continued)

Parameter	Sampling dates		
	3/14	4/12	10/23
Total metals (mg/L) (continued)			
Iron	1.5	1.3	0.08
Lead	<0.005	<0.005	<0.005
Manganese	0.045	0.052	0.02
Mercury	<0.0002	<0.0002	<0.0002
Molybdenum	<0.025	<0.025	<0.025
Nickel	0.007	0.006	<0.002
Selenium	<0.002	<0.002	<0.002
Silver	<0.001	<0.001	<0.001
Thallium	<0.001	<0.001	<0.001
Vanadium	<0.01	<0.01	<0.01
Zinc	0.03	<0.02	<0.02
Volatile organic compounds (µg/L)			
1,1,1-Trichloroethane	na	<0.5	<0.5
1,1,2,2-Tetrachloroethane	na	<0.5	<0.5
1,1,2-Trichloroethane	na	<0.5	<0.5
1,1-Dichloroethane	na	<0.5	<0.5
1,1-Dichloroethene	na	<0.5	<0.5
1,2-Dichlorobenzene	na	<0.5	<0.5
1,2-Dichloroethane	na	1.3	<0.5
1,2-Dichloroethene (total)	na	<1	<1
1,2-Dichloropropane	na	<0.5	<0.5
1,3-Dichlorobenzene	na	<0.5	<0.5
1,4-Dichlorobenzene	na	<0.5	<0.5
Bromodichloromethane	na	<0.5	<0.5
Bromoform	na	<0.5	<0.5
Bromomethane	na	<0.5	<0.5
Carbon tetrachloride	na	<0.5	<0.5
Chlorobenzene	na	<0.5	<0.5
Chloroethane	na	<1	<1
Chloroform	na	<0.5	<0.5
Chloromethane	na	1.2	<1
cis-1,2-Dichloroethene	na	<0.5	<0.5
cis-1,3-Dichloropropene	na	<0.5	<0.5
Dibromochloromethane	na	<0.5	<0.5
Dichlorodifluoromethane	na	<0.5	<0.5
Freon 113	na	<0.5	<0.5

**Table 7-17. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000 (continued)**

Parameter	Sampling dates		
	3/14	4/12	10/23
Volatile organic compounds (µg/L) (continued)			
Methylene chloride	na	<1	<1
Tetrachloroethene	na	<0.5	<0.5
Total Trihalomethanes	na	<2	<2
trans-1,2-Dichloroethene	na	<0.5	<0.5
trans-1,3-Dichloropropene	na	<0.5	<0.5
Trichloroethene	na	<0.5	<0.5
Trichlorofluoromethane	na	<0.5	<0.5
Vinyl chloride	na	<0.5	<0.5
Herbicides (µg/L)			
Acenaphthylene	<0.2	<0.1	<0.1
Alachlor	<0.3	<0.2	<0.2
Aldrin	<0.6	<0.5	na
Anthracene	<0.2	<0.1	<0.1
Atraton	<0.6	<0.5	<0.5
Atrazine	<0.3	<0.2	<0.5
Benzo(a)anthracene	<0.4	<0.3	<0.3
Benzo(a)pyrene	<0.2	<0.1	<0.1
Benzo(b)fluoranthene	<0.4	<0.3	<0.3
Benzo(g,h,i)perylene	<0.4	<0.3	<0.3
Benzo(k)fluoranthene	<0.4	<0.3	<0.3
BHC, delta isomer	<0.3	<0.2	<0.2
BHC, gamma isomer (Lindane)	<0.2	<0.1	<0.1
Bromacil	<0.6	<0.5	<1
Butachlor	<0.4	<0.3	na
Butylbenzylphthalate	<2	<1	<2
Chlordane	<3	<2	na
Chrysene	<0.4	<0.3	<0.3
Di (2-ethylhexyl) adipate	<2	<1	<1
Diazinon	<0.3	<0.2	<0.2
Dibenzo(a,h)anthracene	<0.4	<0.3	<0.3
Dibutylphthalate	<2	<1	<1
Diethylhexylphthalate	<4	<3	<3
Diethylphthalate	<4	<3	na
Dimethoate	<3	<2	<2
Dimethylphthalate	<2	<1	<1
Diuron	<2	<1	<1



Table 7-17. Semiannual/annual analyses of water samples collected from the Drainage Retention Basin location CDBE, 2000 (concluded)

Parameter	Sampling dates		
	3/14	4/12	10/23
Volatile organic compounds (µg/L) (continued)			
Endrin	<0.3	<0.2	na
Fluorene	<0.2	<0.1	<0.1
Glyphosate	<9	<9	<9
Heptachlor	<0.2	<0.1	na
Heptachlor epoxide	<0.2	<0.1	na
Hexachlorobenzene	<0.6	<0.5	<0.1
Hexachlorocyclopentadiene	<2	<1	<1
Indeno(1,2,3-c,d)pyrene	<0.4	<0.3	<0.3
Methoxychlor	<0.6	<0.5	<0.5
Metolachlor	<0.6	<0.5	<0.5
Metribuzin	<0.6	<0.5	<0.5
Molinate	<0.6	<0.5	<0.5
Pentachlorophenol	<2	<1	
Phenanthrene	<0.2	<0.1	<0.1
Prometon	<0.6	<0.5	<0.5
Prometryn	<0.6	<0.5	<0.5
Propachlor	<0.6	<0.5	na
Pyrene	<0.2	na	na
Pyrene	na	<0.1	<0.1
Secbumeton	<0.6	<0.5	<0.5
Simazine	<0.3	<0.2	<0.5
Terbutryn	<0.6	<0.5	<0.5
Thiobencarb	<0.6	<0.5	<0.5
Miscellaneous organics			
Total organic carbon (TOC)	na	11	4.1
Radioactivity (Bq/L)			
Gross alpha	na	0.088 ± 0.37	0.077 ± 0.06
Gross beta	na	0.115 ± 0.031	<0.043 ± 0.04
Tritium	na	13.3 ± 2.5	15.5 ± 2.8

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See main volume, Chapter 14.

a na = Not analyzed

b IC 25 = 25% inhibition concentration; concentration at which 25% of the organisms show inhibition responses

c IC 50 = 50% inhibition concentration; concentration at which 50% of the organisms show inhibition responses

d LOEC = Lowest observed effect concentration

e NOEC = No observed effect concentration

f LC 50 = 50% lethal concentration; concentration at which 50% of the organisms die



Table 7-18. Field data collected from the Drainage Retention Basin at eight locations, 2000

Date	CDBA		CDBC		CDBD		CDBE		
	Dissolved oxygen (mg/L)	Temperature (°C)	Turbidity (m)						
1/7	9.3	10.5	9.0	10.1	9.9	9.8	8.0	9.9	—(a)
1/14	6.6	15.0	7.6	14.9	7.3	14.8	7.0	14.1	0.43
1/19	6.7	15.2	7.7	14.8	7.2	14.5	7.0	14.2	0.46
1/26	7.7	15.0	8.9	14.7	8.3	14.5	8.7	12.5	0.51
2/2	7.6	15.2	8.8	12.3	8.4	12.1	8.7	12.2	0.61
2/11	7.7	15.4	8.8	12.1	8.4	12.2	8.6	12.2	0.56
2/18	8.3	16.1	8.9	16.3	9.1	16.2	9.0	15.8	0.46
2/23	8.3	16.3	9.3	10.2	9.3	10.8	9.1	10.7	0.30
3/3	6.6	21.0	9.3	14.0	7.4	13.2	7.2	13.4	0.43
3/10	8.7	16.0	9.7	13.9	7.9	12.9	7.8	12.9	0.43
3/14	8.1	17.2	9.6	17.8	8.2	16.0	7.9	16.1	0.33
3/24	8.7	17.9	8.4	15.0	8.3	15.4	8.2	15.4	0.36
3/30	8.6	18.8	8.4	20.0	9.0	16.7	8.4	16.7	0.33
4/7	9.6	29.5	8.9	21.1	8.7	19.8	8.6	19.9	0.33
4/10	10.9	21.6	10.0	19.9	9.2	19.7	8.8	20.0	0.46
4/21	8.1	20.5	8.8	18.7	8.3	17.7	7.8	17.4	0.56
4/26	9.8	23.3	10.3	23.6	10.5	20.3	9.9	20.3	0.36
5/4	16.8	21.0	19.0	20.5	16.0	19.8	15.2	19.7	0.58
5/11	12.1	21.4	10.9	20.3	11.0	18.0	9.3	17.7	0.76
5/18	7.1	24.5	6.3	23.4	4.3	19.2	3.5	19.2	0.91
5/26	7.6	17.2	7.0	18.4	5.9	20.8	5.9	20.3	0.47
6/2	8.5	26.5	7.0	21.8	6.9	21.5	5.3	22.3	0.71
6/9	11.2	19.1	11.6	21.3	11.7	20.5	10.5	20.4	1.00
6/15	9.7	33.2	7.6	31.9	8.7	27.4	7.7	27.5	1.09
6/22	8.0	25.9	4.8	27.0	2.5	25.5	4.8	25.5	0.51
6/30	11.0	24.8	7.4	23.8	7.1	26.1	6.6	26.1	0.41
7/7	11.7	21.9	9.1	22.1	7.7	21.8	7.3	21.7	0.76
7/11	10.5	24.0	9.2	24.2	8.2	23.7	8.2	23.9	0.91
7/21	11.5	24.7	9.4	23.9	8.5	24.3	8.4	24.2	0.94
7/28	10.4	23.8	8.4	23.5	6.0	24.3	5.5	24.5	0.98
8/4	8.8	24.0	6.8	23.1	9.2	26.3	8.6	26.4	0.79
8/11	6.6	29.0	4.9	28.0	5.3	24.9	5.0	24.8	0.55
8/18	7.3	27.7	5.5	24.6	5.2	24.4	5.3	24.5	0.61
8/22	6.6	28.9	4.9	28.6	5.1	25.3	5.1	25.1	0.51
9/1	6.6	21.1	7.2	20.0	6.7	22.0	6.6	21.8	0.69

**Table 7-18. Field data collected from the Drainage Retention Basin at eight locations, 2000 (continued)**

Date	CDBF		CDBJ		CDBK		CDBL	
	Dissolved oxygen (mg/L)	Temperature (°C)						
1/7	8.1	9.7	8.9	9.8	8.3	9.8	8.0	10.0
1/14	6.0	14.3	7.4	14.7	7.4	14.5	7.0	15.4
1/19	5.5	14.1	7.3	14.4	7.3	14.3	7.0	15.0
1/26	8.8	12.4	8.6	13.3	8.5	12.6	8.2	12.5
2/2	8.7	12.5	8.7	12.3	8.6	12.2	8.1	12.2
2/11	8.7	12.2	8.6	12.3	8.5	12.3	8.2	12.3
2/18	8.8	15.1	9.0	15.5	8.9	15.3	8.8	15.0
2/23	9.0	10.7	8.2	11.2	9.0	11.2	9.0	11.4
3/3	7.1	13.6	7.7	13.3	7.5	13.4	7.2	13.6
3/10	7.8	13.0	8.7	12.5	8.2	12.4	7.3	12.5
3/14	7.7	16.8	8.3	15.2	8.0	15.2	7.8	15.5
3/24	8.4	15.4	8.5	15.4	8.5	15.3	8.2	15.2
3/30	7.2	17.4	8.3	15.9	8.3	16.0	7.8	16.1
4/7	8.0	20.9	10.5	19.8	8.7	20.0	7.8	20.3
4/10	8.5	20.4	10.0	19.7	9.1	19.7	8.8	19.9
4/21	6.1	17.4	8.5	18.5	8.4	18.2	7.0	18.3
4/26	8.0	21.6	11.1	20.5	8.4	19.9	5.7	20.6
5/4	3.7	19.4	19.0	20.4	17.1	19.9	3.3	19.0
5/11	5.9	17.7	12.2	20.1	11.7	18.0	7.1	18.1
5/18	3.1	20.5	5.6	19.7	4.0	19.6	3.1	19.9
5/26	6.1	18.9	6.2	20.6	6.3	20.3	6.2	19.9
6/2	2.8	22.0	9.7	24.0	5.8	21.7	3.2	21.8
6/9	10.0	20.5	12.0	20.9	11.7	21.0	11.7	21.2
6/15	6.9	27.3	7.5	26.6	7.0	26.6	6.8	26.7
6/22	2.2	25.6	6.5	25.7	6.2	25.5	6.2	25.5
6/30	5.9	26.1	7.2	26.5	7.1	26.5	6.8	26.6
7/7	6.9	21.7	8.9	22.0	8.7	21.9	8.4	22.0
7/11	8.0	22.8	9.2	24.3	8.2	24.2	8.0	23.6
7/21	8.2	24.2	9.1	24.7	8.9	24.6	8.3	24.5
7/28	4.8	24.7	8.6	24.0	8.8	23.8	7.7	23.8
8/4	8.5	23.4	8.8	26.5	9.7	26.2	7.7	26.3
8/11	4.9	25.6	5.7	25.6	5.4	26.4	5.4	27.0
8/18	5.1	24.4	5.7	25.0	5.5	25.1	5.3	25.3
8/22	4.9	24.7	5.4	24.9	5.6	25.2	5.4	25.0
9/1	5.9	21.8	7.0	22.0	6.6	21.7	6.9	21.1



Table 7-18. Field data collected from the Drainage Retention Basin at eight locations, 2000 (continued)

Date	CDBA		CDBC		CDBD		CDBE		
	Dissolved oxygen (mg/L)	Temperature (°C)	Turbidity (m)						
9/8	11.3	26.6	9.5	23.4	8.7	22.3	8.6	22.5	0.66
9/14	10.9	22.3	8.2	22.1	8.4	22.3	7.9	22.3	0.69
9/21	7.6	30.0	7.9	23.7	7.8	23.7	7.6	23.5	0.80
9/29	8.9	29.5	8.3	22.4	7.7	22.0	7.6	21.8	1.04
10/6	7.2	17.7	6.7	20.0	7.2	21.8	6.5	21.6	1.47
10/13	11.2	21.5	10.6	18.5	11.6	18.9	11.1	18.8	1.02
10/20	9.0	21.0	8.8	18.2	8.6	19.4	8.4	19.3	1.02
10/23	9.4	21.7	8.2	16.4	8.4	16.9	8.1	16.8	1.42
11/2	9.3	18.1	9.8	16.1	9.1	16.0	8.9	15.9	1.52
11/10	10.6	13.0	10.3	12.3	10.2	14.1	10.1	14.1	1.78
11/16	11.2	13.5	10.6	12.5	10.8	12.6	10.1	12.5	1.91
11/22	11.3	11.2	10.1	11.1	9.7	11.6	9.5	11.5	2.01
11/29	11.1	15.2	9.5	12.4	9.3	12.4	9.2	12.4	1.96
12/8	7.8	—(b)	7.2	—(b)	7.7	—(b)	6.7	—(b)	1.83
12/14	7.7	—(b)	6.1	—(b)	6.9	—(b)	5.8	—(b)	1.27
Data summary									
Number of samples	50	48	50	48	50	48	50	48	49
Minimum	6.6	10.5	4.8	10.1	2.5	9.8	3.5	9.9	0.30
Maximum	16.8	33.2	19.0	31.9	16.0	27.4	15.2	27.5	2.0
Median	8.8	21.1	8.8	20.0	8.4	19.6	8.1	19.5	0.7
Interquartile range	3.1	8.3	2.1	8.5	1.9	7.6	2.0	8.2	0.56

**Table 7-18. Field data collected from the Drainage Retention Basin at eight locations, 2000 (concluded)**

Date	CDBF		CDBJ		CDBK		CDBL	
	Dissolved oxygen (mg/L)	Temperature (°C)						
9/8	8.5	22.6	9.2	22.2	8.7	22.1	8.9	22.6
9/14	7.6	22.3	9.1	22.4	8.9	22.3	8.8	22.2
9/21	7.7	23.3	8.0	24.0	7.9	24.1	7.8	24.2
9/29	7.2	22.1	7.8	22.3	7.7	22.3	7.1	23.2
10/6	6.3	21.2	6.7	20.8	6.6	20.6	6.7	19.2
10/13	10.6	18.9	11.0	19.2	10.9	19.3	10.5	20.5
10/20	8.1	19.1	8.5	19.6	8.4	19.6	7.8	19.2
10/23	7.9	16.4	8.0	17.4	7.7	17.5	7.3	17.8
11/2	8.7	15.8	8.9	16.5	8.9	16.5	8.7	17.2
11/10	9.9	14.0	10.1	13.8	10.2	13.7	10.1	13.3
11/16	10.0	12.4	10.6	12.3	10.6	12.3	10.6	12.2
11/22	9.3	11.4	10.2	11.5	10.1	11.4	9.9	11.1
11/29	9.1	12.4	9.7	12.3	9.6	12.3	9.5	12.3
12/8	6.2	—(b)	7.2	—(b)	7.0	—(b)	6.4	—(b)
12/14	5.4	—(b)	5.9	—(b)	5.9	—(b)	4.5	—(b)
Data summary								
Number of samples	50	48	50	48	50	48	50	48
Minimum	2.2	9.7	5.4	9.8	4.0	9.8	3.1	10
Maximum	10.6	27.3	19.0	26.6	17.1	26.6	11.7	27
Median	7.7	19.3	8.6	19.8	8.4	19.7	7.7	19.6
Interquartile range	2.6	8.1	1.7	8.2	1.7	7.9	1.6	7.8

a Turbidity measurement not taken

b Measurements not taken because of equipment failure



Table 7-19. Seasonal inventory of plants and animals, Livermore site, 2000

Common name	Scientific name	Location					
		DRB		Arroyo Las Positas		Tributaries	
		Spring ^(a)	Fall ^(b)	Spring	Fall	Spring	Fall
Birds							
American coot	<i>Fulica americana</i>	NO ^(c)	P ^(d)	NO	NO	NO	NO
American crow	<i>Corvus brachyrhynchos</i>	P	P	P	P	P	P
American goldfinch	<i>Carduelis tristis</i>	NO	P	NO	P	NO	P
American kestrel	<i>Falco sparverius</i>	P	P	P	P	NO	NO
American robin	<i>Turdus migratorius</i>	P	P	P	P	NO	NO
Anna's hummingbird	<i>Calypte anna</i>	P	P	P	P	P	P
Belted kingfisher	<i>Ceryle alcyon</i>	P	P	P	P	NO	NO
Bewick's wren	<i>Thryomanes bewickii</i>	P	NO	NO	NO	NO	NO
Black phoebe	<i>Sayornis saya</i>	NO	NO	P	P	NO	NO
Black-chinned hummingbird	<i>Archilochus alexandri</i>	NO	NO	NO	NO	NO	NO
Black-crowned night-heron	<i>Nycticorax nycticorax</i>	NO	P	NO	P	NO	NO
Black-necked stilt	<i>Himantopus mexicanus</i>	P	P	NO	NO	NO	NO
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	P	P	P	P	P	P
Brown-headed cowbird	<i>Molothrus ater</i>	NO	NO	P	NO	NO	NO
Bufflehead	<i>Bucephala</i>	P	P	NO	NO	NO	NO
Bushtit	<i>Psaltriparus minimus</i>	NO	NO	NO	NO	P	P
Canada goose	<i>Branta canadensis</i>	P	P	NO	NO	NO	NO
Cedar waxwing	<i>Bombycilla garrulus</i>	P	NO	NO	NO	P	NO
Chestnut-backed chickadee	<i>Parus rufescens</i>	P	NO	P	NO	NO	NO
Cliff swallow	<i>Hirundo pyrrhonota</i>	P	NO	NO	NO	NO	NO
Common raven	<i>Corvus corax</i>	NO	NO	P	P	NO	NO
Common snipe	<i>Gallinago gallinago</i>	NO	P	NO	P	NO	NO
Dark-eyed junco	<i>Junco hyemalis</i>	P	NO	P	NO	NO	NO
Double-crested cormorant	<i>Phalacrocorax auritus</i>	P	P	NO	NO	NO	NO
European starling	<i>Sturnus vulgaris</i>	P	P	P	P	P	P
Great blue heron	<i>Ardea herodias</i>	NO	NO	P	NO	NO	NO
Great egret	<i>Casmerodius albus</i>	P	P	P	P	NO	NO
Greater Scaup	<i>Aythya marila</i>	NO	NO	NO	NO	NO	NO
Greater-yellow legs	<i>Tringa melanoleuca</i>	P	P	NO	NO	NO	NO
Green-backed heron	<i>Butorides striatus</i>	P	P	P	P	NO	NO
House finch	<i>Carpodacus mexicanus</i>	P	P	P	P	P	P
Killdeer	<i>Charadrius vociferus</i>	P	P	NO	NO	NO	NO
Lesser goldfinch	<i>Carduelis lawrencei</i>	NO	P	NO	P	NO	P

**Table 7-19. Seasonal inventory of plants and animals, Livermore site, 2000 (continued)**

Common name	Scientific name	Location					
		DRB		Arroyo Las Positas		Tributaries	
		Spring ^(a)	Fall ^(b)	Spring	Fall	Spring	Fall
Birds (continued)							
Loggerhead shrike	<i>Lanius ludovicianus</i>	NO	NO	P	NO	NO	NO
Mallard	<i>Anas platyrhynchos</i>	P	P	NO	NO	P	P
Mourning dove	<i>Zenaida macroura</i>	P	P	P	P	P	P
Nuttall's woodpecker	<i>Picoides nuttallii</i>	NO	NO	P	NO	P	NO
Pied-billed grebe	<i>Podilymbus podiceps</i>	P	P	NO	NO	NO	NO
Red-shafted flicker	<i>Colaptes auratus</i>	P	P	P	P	NO	NO
Red-shouldered hawk	<i>Buteo lineatus</i>	NO	NO	P	P	NO	NO
Red-tailed hawk	<i>Buteo jamaicensis</i>	NO	NO	P	P	P	P
Red-winged blackbird	<i>Agelaius phoeniceus</i>	P	P	P	P	P	P
Rock dove	<i>Columba livia</i>	P	P	P	P	P	P
Ruby-crowned kinglet	<i>Regulus caledula</i>	P	P	NO	NO	NO	NO
Scrub jay	<i>Aphelocoma coerulescens</i>	P	P	P	P	P	P
Snowy egret	<i>Egretta thula</i>	NO	NO	P	P	NO	NO
Song sparrow	<i>Zmelospiza melodia</i>	P	P	P	P	P	P
Turkey vulture	<i>Cathartes aura</i>	NO	NO	P	P	NO	NO
Western gull	<i>Larus occidentalis</i>	NO	P	NO	NO	NO	NO
Western meadowlark	<i>Sturnella neglecta</i>	NO	NO	P	P	NO	NO
White-breasted nuthatch	<i>Sitta carolinensis</i>	NO	NO	NO	NO	P	NO
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	P	P	P	P	P	P
White-tailed kite	<i>Elanus leucurus</i>	NO	NO	P	P	NO	NO
Yellow-rumped warbler	<i>Dendroica coronata</i>	P	P	P	P	P	P
Amphibians and reptiles							
Bullfrog	<i>Rana catesbeiana</i>	P	P	NO	NO	NO	NO
Pacific tree frog	<i>Hyla regilla</i>	P	P	P	P	P	P
California red-legged frog	<i>Rana aurora draytonii</i>	NO	NO	P	P	P	P
Western fence lizard	<i>Sceloporus occidentalis</i>	P	P	P	NO	P	P
Western pond turtle	<i>Clemmys marmorata</i>	NO	P	NO	NO	NO	NO
Western toad	<i>Bufo boreas</i>	P	P	P	P	P	P
Fish							
Catfish	<i>Ictalurus sp.</i>	—(e)	P	—(e)	P	—(e)	NO
goldfish	<i>Carrassius auratus</i>	—(e)	P	—(e)	NO	—(e)	NO
Mosquito fish	<i>Gambusia affinis</i>	—(e)	P	—(e)	P	—(e)	P
Prickly sculpin	<i>Cottus asper</i>	—(e)	P	—(e)	P	—(e)	P



Table 7-19. Seasonal inventory of plants and animals, Livermore site, 2000 (concluded)

Common name	Scientific name	Spring ^(a)	Fall ^(b)
Mammals (all locations)			
California ground squirrel	<i>Spermophilus beecheyi</i>	—(e)	P
California meadow vole	<i>Microtus californicus</i>	—(e)	P
Feral house cat	<i>Felis domesticus</i>	—(e)	P
Gray fox	<i>Urocyon cinereoargenteus</i>	—(e)	P
House mouse	<i>Mus musculus</i>	—(e)	P
muskrat	<i>Ondatra zibethicus</i>	—(e)	P
Red fox	<i>Vulpes vulpes</i>	—(e)	P
Vegetation (all locations)			
Alkali mallow	<i>Malvella leprosa</i>	P	P
Alkaline bullrush	<i>Scirpus robustus</i>	P	P
American water-plantain	<i>Alisma plantago-aquatica</i>	P	P
Bullrush	<i>Scripus spp.</i>	P	P
Cattail	<i>Typha latifolia</i>	P	P
Cocklebur	<i>Xanthium spinosum</i>	P	P
Coontail	<i>Ceratophyllum demersum</i>	P	P
Curly dock	<i>Rumex crispus</i>	P	P
Harding grass	<i>Phalaris aquatica</i>	P	P
Leafy pondweed	<i>Potamogeton foliosus</i>	P	P
Mulefat	<i>Baccharis salicifolius</i>	P	P
Narrow-leaved willow	<i>Salix exigua</i>	P	P
Red willow	<i>Salix laevigata</i>	P	P
Salt grass	<i>Distichlis spicata</i>	P	P
Spearscale	<i>Atriplex triangularis</i>	P	P
Tall flatsedge	<i>Cyperus eragrostis</i>	P	P
Water velvet	<i>Azolla mexicana</i>	P	P
Watercress	<i>Rorippa nasturium-aquaticum</i>	P	P
Waterpeper	<i>Polygonum hydropiperoides</i>	P	P
Willow	<i>Salix spp.</i>	P	P

a Spring survey dates are as follows: amphibians: 2/10/00, 2/15/00, 3/10/00, and 3/20/00; birds: 2/18/00, 2/25/00, 3/3/00, and 3/17/00; and vegetation: 3/00.

b Fall survey dates are as follows: amphibians: 8/21/00, 10/24/00, 11/6/00, and 11/16/00; birds: 10/13/00, 10/26/00, 11/3/00, and 11/16/00; fish: 12/23/00 and 1/12/01; mammals: 10/27–30/00; and vegetation: 9/00.

c NO = Not observed

d P = Present

e Only fall surveys were completed for fish and mammals.

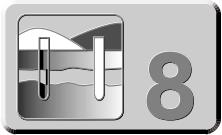
**Table 7-20. Radioactivity in surface and drinking water (Bq/L) in the Livermore Valley, 2000**

Locations	Date	Tritium	Gross alpha	Gross beta
Drinking waters				
BELL	1/12	-0.06 ± 2.02	0.02 ± 0.02	0.11 ± 0.03
	7/11	0.15 ± 0.97	0.01 ± 0.02	0.07 ± 0.02
GAS	1/11	-0.17 ± 2.01	0.04 ± 0.04	0.07 ± 0.04
	7/11	1.89 ± 1.11	0.03 ± 0.03	0.11 ± 0.04
PALM	1/12	-0.70 ± 1.97	0.01 ± 0.02	0.11 ± 0.03
	7/11	0.41 ± 0.99	0.10 ± 0.06	0.25 ± 0.05
ORCH	1/11	-0.68 ± 1.99	0.02 ± 0.06	0.20 ± 0.07
	7/11	0.48 ± 1.00	0.04 ± 0.05	0.46 ± 0.11
TAP	1/12	0.34 ± 2.03	0.02 ± 0.02	0.03 ± 0.01
	7/11	-0.51 ± 1.04	— ^(a)	0.03 ± 0.01
Surface waters				
CAL	1/11	0.25 ± 2.03	0.02 ± 0.02	0.07 ± 0.02
	7/11	0.20 ± 0.97	0.00 ± 0.01	0.06 ± 0.02
DEL	1/11	-0.97 ± 1.99	0.02 ± 0.03	0.11 ± 0.03
	7/11	0.44 ± 0.99	0.02 ± 0.02	0.10 ± 0.03
DUCK	1/11	0.20 ± 2.02	0.23 ± 0.13	0.25 ± 0.10
	7/11	0.42 ± 1.00	0.12 ± 0.14	0.32 ± 0.13
ALAG	1/11	1.08 ± 2.06	0.03 ± 0.06	0.14 ± 0.05
	7/11	-0.01 ± 0.95	0.20 ± 0.09	0.17 ± 0.06
SHAD	1/12	0.41 ± 2.03	0.08 ± 0.06	0.17 ± 0.05
	7/11	0.85 ± 1.04	0.09 ± 0.06	0.15 ± 0.05
ZON7	1/11	-1.52 ± 1.95	0.02 ± 0.02	0.12 ± 0.03
	7/11	0.64 ± 1.02	0.02 ± 0.02	0.07 ± 0.02
On-site pool				
POOL	1/12	2.65 ± 2.16	0.06 ± 0.05	0.22 ± 0.09
	4/20	1.86 ± 2.09	— ^(b)	— ^(b)
	7/11	2.92 ± 1.19	0.23 ± 0.09	0.06 ± 0.05
	10/5	4.51 ± 3.52	— ^(b)	— ^(b)

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See main volume, Chapter 14.

a Analyte missed. Analytical laboratory did not perform the analysis for gross alpha radiation.

b Sampled semiannually. POOL samples are collected quarterly for tritium and semiannually for gross alpha and gross beta radiation.



**There are no supplemental data in this chapter.
Please see the main volume for details about
Groundwater Investigation and Remediation.**



GROUNDWATER MONITORING

Eric Christofferson
Richard A. Brown

Methods

Representative samples of groundwater from monitoring wells were obtained by following the written protocols contained in the *LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (SOPs)* (Dibley and Depue 2000), which are updated annually. The protocols cover sampling techniques and specific information for the analytes that are routinely searched for in groundwater. Different sampling techniques were applied to different wells depending on whether they were fitted with submersible pumps, had to be bailed, or contained Barcad devices, where LLNL used nitrogen gas under pressure to extract water samples.

Typically, sampling technologists purged wells of standing water and waited for the wells to recover before they collected water samples. They wore disposable vinyl gloves to prevent accidental contamination during sampling and cleaned pH and depth-to-water probes with deionized water after each use. For quality assurance purposes, they obtained field blank samples and equipment blank samples to test the cleanliness of the sampling methods. They used clean sample containers and, where required, they used ultrapure chemicals (mostly acids) to preserve the samples.

Off-site laboratories performed most of the water analyses during 2000, under contract with LLNL. LLNL personnel primarily measured tritium activity in an on-site laboratory dedicated to that purpose. (Note that the groundwater radioactivity data for 2000 include some small negative values [in Bq/L]. These can occur when the independently determined correction for background radioactivity is subtracted from measurements of groundwaters that contain little or no radioactive material.)

As with groundwater sampling, standard sample handling and hygiene procedures were employed to prevent cross-contamination (e.g., wearing disposable gloves, decontaminating sampling equipment, and maintaining samples at $4 \pm 2^\circ$ Celsius). Replicates, field blanks, and trip blanks were collected for quality assurance/quality control purposes. Most analyses were performed off site by contract analytical laboratories except when the on-site laboratory offered better capabilities and/or detection limits.

Technologists sampled wastewater from the chemistry area in retention tanks associated with Buildings 825, 826, and 827 using Hazardous Waste Management Procedure 411. Wastewater was held in retention tanks until analytical results were reviewed for compliance with Waste Discharge Requirements No. 96-248.



Livermore Site

Table 9-1 lists the groundwater constituents monitored at the Livermore site and at Site 300, the EPA (or other)-approved methods commonly used to measure them, and the detection limits (reporting limits) employed.

Tables 9-2 to 9-11 report routine surveillance monitoring for wells along the Livermore site perimeter; wells W-008, W-017, and W-221 are upgradient and the remaining seven wells are downgradient from the site. Tables 9-12 and 9-13 contain analytical data obtained from monitoring wells downgradient from the Taxi Strip Area, and Tables 9-14 through 9-18 contain analytical data obtained from monitoring wells downgradient from the East Traffic Circle Area. Table 9-19 contains data from W-593, downgradient from the Decontamination and Waste Treatment Facility. Tables 9-20 through 9-22 contain data from wells downgradient from the Hazardous Waste Management facilities near Buildings 514 and 612. Tables 9-23 through 9-25 list results of metals analyses from wells downgradient from where metal wastes are managed. Table 9-26 contains data from monitoring well W-305 just upgradient from the Superblock, containing the Plutonium and Tritium Facilities. Data from SIP-331-001, just downgradient from the Plutonium Facility, are contained in Table 9-27; data from well W-148, downgradient from both the Plutonium and Tritium Facilities, are contained in Table 9-28. Tritium activities in 10 selected Livermore site surveillance wells surrounding the Tritium Facility are listed in Table 9-29.

Tritium activities in groundwater at 20 production and monitoring wells in the Livermore Valley are listed in Table 9-30.

Nitrate concentrations in 10 selected Livermore site surveillance wells are contained in Table 9-31.

Site 300

Tables 9-32 through 9-46 contain chemical data for Site 300 surveillance monitoring wells (Elk ravine drainage area, including closed landfill pits 2, 8, and 9, and Corral Hollow creek drainage area, including closed high-explosives burn pit, standby water supply, active water supply, and off-site wells).

Additional chemical data for Site 300 groundwater that was obtained during 2000 from compliance monitoring of closed landfill pits 1, 6, and 7, the active surface water impoundments, and the sewage ponds can be found in published compliance monitoring reports (Brown 2001; Christofferson and MacQueen 2001; and Christofferson et al. 2001).

**Table 9-1a. Analytical methods and contractual reporting limits for inorganic constituents of concern in groundwater**

Constituents of concern	Analytical method	Reporting limit ^(a,b)
Metals and minerals (mg/L)		
All alkalinites	EPA 310.1	1
Aluminum	EPA 200.7	0.05 or 0.2
Ammonia nitrogen (as N)	EPA 350.3, 350.2, or 350.1	0.03 or 0.1
Antimony	EPA 204.2	0.005
Arsenic	EPA 206.2	0.002
Barium	EPA 200.7	0.025 or 0.01
Beryllium	EPA 210.2	0.0005 or 0.0002
Boron	EPA 200.7	0.05
Cadmium	EPA 213.2	0.0005
Calcium	EPA 200.7	0.5
Chloride	EPA 300.0	1 or 0.5
Chromium	EPA 218.2 or 200.7	0.001
Chromium(VI)	EPA 218.4 or EPA 7196	0.002
Cobalt	EPA 200.7	0.025 or 0.05
Copper	EPA 220.2 or 200.7	0.001, 0.01 or 0.05
Fluoride	EPA 340.2 or 340.1	0.05
Hardness, total (as CaCO ₃)	SM 2320B	1
Iron	EPA 200.7	0.1
Lead	EPA 239.2	0.002 or 0.005
Magnesium	EPA 200.7	0.5
Manganese	EPA 200.7	0.03
Mercury	EPA 245.2 or 245.1	0.0002
Molybdenum	EPA 200.7	0.025
Nickel	EPA 249.2 or 200.7	0.002, 0.005 or 0.1
Nitrate (as NO ₃)	EPA 353.2, 354.1 or 300.0	0.5
Orthophosphate	EPA 300.0, 365.1 or 365.2	0.05
Perchlorate	EPA 314.0	0.004
Potassium	EPA 200.7	1
Selenium	EPA 270.2	0.002
Silver	EPA 272.2	0.001 or 0.0005
Sodium	EPA 200.7	1 or 0.1
Sulfate	EPA 300.0	1
Surfactants	EPA 425.1	0.5
Thallium	EPA 279.2	0.001
Total dissolved solids	EPA 160.1	1
Total Kjeldahl nitrogen	EPA 351.2 or 351.3	0.2

**Table 9-1a. Analytical methods and contractual reporting limits for inorganic constituents of concern in groundwater (concluded)**

Constituents of concern	Analytical method	Reporting limit ^(a,b)
Metals and minerals (mg/L) (continued)		
Total suspended solids	EPA 160.2	1
Vanadium	EPA 200.7	0.02 or 0.025
Zinc	EPA 200.7	0.02 or 0.05
Phenolics (mg/L)		
Phenolics	EPA 420.1	0.005
General indicator parameters		
pH (pH units)	EPA 150.1	none
Specific conductance ($\mu\text{S}/\text{cm}$)	EPA 120.1	none
Total organic carbon (mg/L)	EPA 9060	1
Total organic halides (mg/L)	EPA 9020	0.01
Explosive compounds ($\mu\text{g}/\text{L}$)		
HMX ^(c)	EPA 8330	5 or 1
RDX ^(d)	EPA 8330	5 or 1
TNT ^(e)	EPA 8330	5
Radioactivity (Bq/L)		
Gross alpha	EPA 900	0.037
Gross beta	EPA 900	0.037
Radioisotopes (Bq/L)		
Americium-241	U-NAS-NS-3050	0.0037
Plutonium-238	U-NAS-NS-3050	0.0037
Plutonium-239+240	U-NAS-NS-3050	0.0037
Radon-222	EPA 913	3.7
Radium-226	EPA 903	0.0093
Radium-228	EPA 904	0.037
Thorium-228	U-NAS-NS-3050	0.009
Thorium-230	U-NAS-NS-3050	0.006
Thorium-232	U-NAS-NS-3050	0.006
Tritium	LLNL-RAS-011	3.7
Uranium-234	U-NAS-NS-3050	0.0037
Uranium-235	U-NAS-NS-3050	0.0037
Uranium-238	U-NAS-NS-3050	0.0037

a The significant figures displayed in this table vary by constituents of concern. These variations reflect regulatory agency permit stipulations, or the applicable analytical laboratory contract under which the work was performed, or both.

b Analytical reporting limits varied by laboratory used.

c HMX is octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

d RDX is hexahydro-1,3,5-trinitro-1,3,5-triazine.

e TNT is 2,4,6-trinitrotoluene.

**Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater**

Constituents of concern	Reporting limit ($\mu\text{g}/\text{L}$) ^(a,b)	Constituents of concern	Reporting limit ($\mu\text{g}/\text{L}$) ^(a,b)
EPA Method 502.2 (or 524.2)		Dichlorodifluoromethane	0.2
1,1,1,2-Tetrachloroethane	0.2	Ethylbenzene	0.2
1,1,1-Trichloroethane	0.2	Freon 113	0.2
1,1,2,2-Tetrachloroethane	0.2	Hexachlorobutadiene	0.2
1,1,2-Trichloroethane	0.2	Isopropylbenzene	0.2
1,1-Dichloroethane	0.2	<i>m</i> - and <i>p</i> -Xylene isomers	0.2
1,1-Dichloroethene	0.2	Methylene chloride	0.2
1,1-Dichloropropene	0.2	<i>n</i> -Butylbenzene	0.2
1,2,3-Trichlorobenzene	0.2	<i>n</i> -Propylbenzene	0.2
1,2,3-Trichloropropane	0.2	Naphthalene	0.2
1,2,4-Trichlorobenzene	0.2	<i>o</i> -Xylene	0.2
1,2,4-Trimethylbenzene	0.2	Isopropyl toluene	0.2
1,2-Dichlorobenzene	0.2	<i>sec</i> -Butylbenzene	0.2
1,2-Dichloroethane	0.2	Styrene	0.2
1,2-Dichloropropane	0.2	<i>tert</i> -Butylbenzene	0.2
1,3,5-Trimethylbenzene	0.2	Tetrachloroethene	0.2
1,3-Dichlorobenzene	0.2	Toluene	0.2
1,3-Dichloropropane	0.2	<i>trans</i> -1,2-Dichloroethene	0.2
1,4-Dichlorobenzene	0.2	<i>trans</i> -1,3-Dichloropropene	0.2
2,2-Dichloropropane	0.2	Trichloroethene	0.2
2-Chlorotoluene	0.2	Trichlorofluoromethane	0.2
4-Chlorotoluene	0.2	Vinyl chloride	0.2
Benzene	0.2	EPA Method 525.2	
Bromobenzene	0.2	Alachlor	0.5
Bromochloromethane	0.2	Atraton	0.5
Bromodichloromethane	0.2	Atrazine	0.5
Bromoform	0.2	Bromacil	0.5
Bromomethane	0.2	Butachlor	0.5
Carbon tetrachloride	0.2	Diazinon	0.5
Chlorobenzene	0.2	Dichlorvos	0.5
Chloroethane	0.2	Dimethoate	0.5
Chloroform	0.2	Ethoprop	0.5
Chloromethane	0.2	Merphos	0.5
cis-1,2-Dichloroethene	0.2	Metolachlor	0.5
cis-1,3-Dichloropropene	0.5	Metribuzin	0.5
Dibromochloromethane	0.2	Mevinphos	0.5
Dibromomethane	0.2	Molinate	0.5

**Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (continued)**

Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)	Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)
EPA Method 525.2 (continued)		Chloromethane	2
Prometon	0.5	cis-1,2-Dichloroethene	1
Prometryn	0.5	cis-1,3-Dichloropropene	1
Simazine	0.5	Dibromochloromethane	1
Terbutryn	0.5	Dibromomethane	1
EPA Method 524.2		Dichlorodifluoromethane	2
1,1,1,2-Tetrachloroethane	1	Ethylbenzene	1
1,1,1-Trichloroethane	1	Ethylene dibromide	1
1,1,2,2-Tetrachloroethane	1	Freon 113	1
1,1,2-Trichloroethane	1	Hexachlorobutadiene	1
1,1-Dichloroethane	1	Isopropylbenzene	1
1,1-Dichloroethene	1	m- and p-Xylene isomers	1
1,1-Dichloropropene	1	Methylene chloride	1
1,2,3-Trichlorobenzene	1	n-Butylbenzene	1
1,2,3-Trichloropropane	1	n-Propylbenzene	1
1,2,4-Trichlorobenzene	1	Naphthalene	1
1,2,4-Trimethylbenzene	1	o-Xylene	1
1,2-Dibromo-3-chloropropane	2	Isopropyl toluene	1
1,2-Dichlorobenzene	1	sec-Butylbenzene	1
1,2-Dichloroethane	1	Styrene	1
1,2-Dichloropropane	1	tert-Butylbenzene	1
1,3,5-Trimethylbenzene	1	Tetrachloroethene	1
1,3-Dichlorobenzene	1	Toluene	1
1,3-Dichloropropane	1	trans-1,2-Dichloroethene	1
1,4-Dichlorobenzene	1	trans-1,3-Dichloropropene	1
2-Chlorotoluene	1	Trichloroethene	0.5
4-Chlorotoluene	1	Trichlorofluoromethane	1
Benzene	1	Vinyl chloride	2
Bromobenzene	1	EPA Method 547	
Bromodichloromethane	1	Glyphosate	20
Bromoform	1	EPA Method 601	
Bromomethane	2	1,1,1-Trichloroethane	0.5
Carbon tetrachloride	1	1,1,2,2-Tetrachloroethane	0.5
Chlorobenzene	1	1,1,2-Trichloroethane	0.5
Chloroethane	2	1,1-Dichloroethane	0.5
Chloroform	1	1,1-Dichloroethene	0.5

**Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (continued)**

Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)	Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)
EPA Method 601 (continued)		EPA Method 602 (continued)	
1,2-Dichlorobenzene	0.5	o-Xylene	0.4
1,2-Dichloroethane	0.5	Toluene	0.3
1,2-Dichloroethene (total)	0.5	Total xylene isomers	0.4
1,2-Dichloropropane	0.5	EPA Method 608	
1,3-Dichlorobenzene	0.5	Aldrin	0.05
1,4-Dichlorobenzene	0.5	BHC, alpha isomer	0.05
2-Chloroethylvinylether	0.5	BHC, beta isomer	0.05
Bromodichloromethane	0.5	BHC, delta isomer	0.05
Bromoform	0.5	BHC, gamma isomer (Lindane)	0.05
Bromomethane	0.5	Chlordane	0.2
Carbon tetrachloride	0.5	Dieldrin	0.1
Chlorobenzene	0.5	Endosulfan I	0.05
Chloroethane	0.5	Endosulfan II	0.1
Chloroform	0.5	Endosulfan sulfate	0.1
Chloromethane	0.5	Endrin	0.1
cis-1,2-Dichloroethene	0.5	Endrin aldehyde	0.1
cis-1,3-Dichloropropene	0.5	Heptachlor	0.05
Dibromochloromethane	0.5	Heptachlor epoxide	0.05
Dichlorodifluoromethane	0.5	Methoxychlor	0.5
Freon 113	0.5	4,4'-DDD	0.1
Methylene chloride	0.5	4,4'-DDE	0.1
Tetrachloroethene	0.5	4,4'-DDT	0.1
trans-1,2-Dichloroethene	0.5	PCBs	0.5
trans-1,3-Dichloropropene	0.5	Toxaphene	1
Trichloroethene	0.5	EPA Method 615	
Trichlorofluoromethane	0.5	2,4,5-T	0.5
Vinyl chloride	0.5	2,4,5-TP (Silvex)	0.2
EPA Method 602		2,4-D	1
1,2-Dichlorobenzene	0.3	2,4-Dichlorophenoxy acetic acid	2
1,3-Dichlorobenzene	0.3	Dalapon	10
1,4-Dichlorobenzene	0.3	Dicamba	1
Benzene	0.4	Dichloroprop	2
Chlorobenzene	0.3	Dinoseb	1
Ethylbenzene	0.3	MCPA	250
m- and p-Xylene isomers	0.4	MPCP	250

**Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (continued)**

Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)	Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)
EPA Method 624		Toluene	1
1,1,1-Trichloroethane	1	Total xylene isomers	2
1,1,2,2-Tetrachloroethane	1	<i>trans</i> -1,2-Dichloroethene	1
1,1,2-Trichloroethane	1	<i>trans</i> -1,3-Dichloropropene	1
1,1-Dichloroethane	1	Trichloroethene	0.5
1,1-Dichloroethene	1	Trichlorofluoromethane	1
1,2-Dichlorobenzene	1	Vinyl acetate	1
1,2-Dichloroethane	1	Vinyl chloride	1
1,2-Dichloroethene (total)	1	EPA Method 625	
1,2-Dichloropropane	1	1,2,4-Trichlorobenzene	5
1,3-Dichlorobenzene	1	1,2-Dichlorobenzene	5
1,4-Dichlorobenzene	1	1,3-Dichlorobenzene	5
2-Butanone	20	1,4-Dichlorobenzene	5
2-Chloroethylvinylether	20	2,4,5-Trichlorophenol	5
2-Hexanone	20	2,4,6-Trichlorophenol	5
4-Methyl-2-pentanone	20	2,4-Dichlorophenol	5
Acetone	10	2,4-Dimethylphenol	5
Benzene	1	2,4-Dinitrophenol	25
Bromodichloromethane	1	2,4-Dinitrotoluene	5
Bromoform	1	2,6-Dinitrotoluene	5
Bromomethane	2	2-Chloronaphthalene	5
Carbon disulfide	1	2-Chlorophenol	5
Carbon tetrachloride	1	2-Methylphenol	5
Chlorobenzene	1	2-Methyl-4,6-dinitrophenol	25
Chloroethane	2	2-Methylnaphthalene	5
Chloroform	1	2-Nitroaniline	25
Chloromethane	2	3,3'-Dichlorobenzidine	10
<i>cis</i> -1,2-Dichloroethene	1	3-Nitroaniline	25
<i>cis</i> -1,3-Dichloropropene	1	4-Bromophenylphenylether	5
Dibromochloromethane	1	4-Chloro-3-methylphenol	10
Dibromomethane	1	4-Chloroaniline	10
Dichlorodifluoromethane	2	4-Chlorophenylphenylether	5
Ethylbenzene	1	4-Nitroaniline	25
Freon 113	1	4-Nitrophenol	25
Methylene chloride	1	Acenaphthene	25
Styrene	1	Acenaphthylene	5
Tetrachloroethene	1	Anthracene	5

**Table 9-1b. Analytical methods and contractual reporting limits for organic constituents of concern in groundwater (concluded)**

Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)	Constituents of concern	Reporting limit ($\mu\text{g/L}$) ^(a,b)
EPA Method 625 (continued)		Nitrobenzene	5
Benzo[a]anthracene	5	Pentachlorophenol	5
Benzo[a]pyrene	5	Phenanthrene	5
Benzo[b]fluoranthene	5	Phenol	5
Benzo[g,h,i]perylene	5	Pyrene	5
Benzo[k]fluoranthene	5	EPA Method 632	
Benzoic acid	25	Diuron	0.1
Benzyl alcohol	10	EPA Method 8082	
Bis(2-chloroethoxy)methane	5	Polychlorinated biphenyls	0.5
Bis(2-chloroisopropyl)ether	5	EPA Method 8140	
Bis(2-ethylhexyl)phthalate	5	Azinphos methyl	1
Butylbenzylphthalate	5	Bolstar	1
Chrysene	5	Chlorpyrifos	1
Di-n-butylphthalate	5	Coumaphos	1
Di-n-octylphthalate	5	Demeton	1
Dibenzo[a,h]anthracene	5	Diazinon	1
Dibenzofuran	5	Dichlorvos	1
Diethylphthalate	5	Disulfoton	1
Dimethylphthalate	5	Ethoprop	1
Fluoranthene	5	Fensulfothion	1
Fluorene	5	Fenthion	1
Hexachlorobenzene	5	Merphos	1
Hexachlorobutadiene	5	Methyl Parathion	1
Hexachlorocyclopentadiene	5	Mevinphos	1
Hexachloroethane	5	Naled	1
Indeno[1,2,3-c,d]pyrene	5	Phorate	1
Isophorone	5	Prothiophos	1
m- and p-Cresol	5	Ronnel	1
N-Nitroso-di-n-propylamine	5	Stirophos	1
N-Nitrosodiphenylamine	5	Trichloronate	1
Naphthalene	5		

a The significant figures displayed in this table vary by constituents of concern. These variations reflect regulatory agency permit stipulations, or the applicable analytical laboratory contract under which the work was performed, or both.

b Analytical reporting limits varied by laboratory used.

**Table 9-2.** Livermore site surveillance well W-008

Constituents of concern	Sampling dates			
	2/9/00	5/10/00	7/27/00	10/9/00
Inorganic ($\mu\text{g/L}$)				
pH (pH units)	na ^(a)	7.7	na	7.6
Field pH (pH units)	7.4	7.3	7.1	7.1
Specific conductance ($\mu\text{S}/\text{cm}$)	na	2300	na	2400
Field specific conductance ($\mu\text{S}/\text{cm}$)	2600	2300	2300	2300
Total dissolved solids (TDS) (mg/L)	na	1600	na	1600
Water temperature ($^{\circ}\text{C}$)	19.6	19.2	19.4	19.3
Aluminum	<50	<50	na	<50
Antimony	<4	na	na	na
Arsenic	3	na	na	na
Barium	<25	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	6.3	na	na	na
Cobalt	<50	na	na	na
Copper	<1	<10	na	<10
Chromium(VI)	7.9	na	7.9	8.4
Iron	<50	180	na	<50
Lead	<5	na	na	na
Manganese	<10	<10	na	<10
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	<2	<50	na	<50
Selenium	<2	na	na	na
Silver	<1	na	na	na
Thallium	<4	na	na	na
Vanadium	20	na	na	na
Zinc	<20	<50	na	<50
General minerals (mg/L)				
Bicarbonate alkalinity (as CaCO_3)	na	240	na	230
Boron	8.7	na	na	na
Calcium	na	110	na	100
Chloride	na	510	na	460
Fluoride	na	1.3	na	1.2
Magnesium	na	56	na	54
Nitrate	19	20	20	21

Table 9-2. Livermore site surveillance well W-008 (concluded)

Constituents of concern	Sampling dates			
	2/9/00	5/10/00	7/27/00	10/9/00
General minerals (mg/L) (continued)				
Orthophosphate	na	0.067	na	0.069
Potassium	na	2.1	na	2.1
Sodium	na	360	na	370
Sulfate	na	340	na	330
Surfactants	na	<0.5	na	<0.5
Total hardness (as CaCO ₃)	na	500	na	470
Total phosphorus (as P)	na	<0.05	na	<0.05
Organic (µg/L)				
EPA Method 525.2	nd ^(b)	nd	na	na
EPA Method 547	na	na	nd	na
EPA Method 632	na	na	nd	na
EPA Method 8140	nd	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.28 ± 0.14	0.18 ± 0.07	na	na
Gross beta	0.27 ± 0.2	0.1 ± 0.1	na	na
Plutonium-238	na	na	na	0.0001 ± 0.0005
Plutonium-239+240	0.0001 ± 0.00039	na	na	<0.0037
Radium-226	0.19 ± 0.05	0.032 ± 0.024	0.38 ± 0.04	0.005 ± 0.004
Radium 228	0.007 ± 0.020	na	na	na
Tritium	-2.1 ± 1.9	-0.48 ± 2	-0.2 ± 2.2	-1.4 ± 2.4
Uranium (total)	0.2 ± 0.04	na	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

**Table 9-3.** Livermore site surveillance well W-221

Constituents of concern	Sampling dates			
	2/9/00	5/10/00	7/27/00	10/9/00
Inorganic ($\mu\text{g/L}$)				
pH (pH units)	na ^(a)	7.6	na	7.4
Field pH (pH units)	7.2	7.1	6.9	6.9
Specific conductance ($\mu\text{S/cm}$)	na	1500	na	1700
Field specific conductance ($\mu\text{S/cm}$)	1600	1600	1500	1600
Total dissolved solids (TDS)	na	1000	na	1000
Water temperature ($^{\circ}\text{C}$)	20.2	20	20.8	20
Aluminum	<50	<50	na	<50
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	110	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	7	na	na	na
Cobalt	<50	na	na	na
Copper	<1	<10	na	<10
Chromium(VI)	4	na	4	5.3
Iron	<50	<50	na	<50
Lead	<5	na	na	na
Manganese	<10	<10	na	<10
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	16	<50	na	<50
Selenium	<2	na	na	na
Silver	<1	na	na	na
Thallium	<4	na	na	na
Vanadium	<10	na	na	na
Zinc	<20	<50	na	<50
General minerals (mg/L)				
Bicarbonate alkalinity (as CaCO_3)	na	340	na	340
Boron	2.4	na	na	na
Calcium	na	150	na	130
Chloride	na	310	na	300
Fluoride	na	0.59	na	0.61

Table 9-3. Livermore site surveillance well W-221 (concluded)

Constituents of concern	Sampling dates			
	2/9/00	5/10/00	7/27/00	10/9/00
General minerals (mg/L) (continued)				
Magnesium	na	51	na	48
Nitrate (as NO ₃)	29	34	29	27
Orthophosphate	na	<0.05	na	<0.05
Potassium	na	2.2	na	2.2
Sodium	na	160	na	160
Sulfate	na	97	na	98
Surfactants	na	<0.5	na	<0.5
Total hardness (as CaCO ₃)	na	580	na	530
Total phosphorus (as P)	na	<0.05	na	<0.05
Organic (µg/L)				
EPA Method 525.2	nd ^(b)	nd	na	na
EPA Method 547	na	na	nd	na
EPA Method 632	na	na	nd	na
EPA Method 8140	nd	nd	na	na
Radioactivity (Bq/L)				
Gross alpha	0.35 ± 0.08	0.21 ± 0.07	na	na
Gross beta	0.19 ± 0.10	0.25 ± 0.09	na	na
Plutonium-238	na	na	na	0.001 ± 0.001
Plutonium-239+240	0.0001 ± 0.0003	na	na	0.0001 ± 0.001
Radium-226	0.17 ± 0.05	na	0.12 ± 0.02	-0.0005 ± 0.004
Radium-228	0.011 ± 0.015	na	na	na
Tritium	2.7 ± 2.1	5.6 ± 2.2	4.4 ± 2.3	<2.4
Uranium (total)	0.25 ± 0.034	na	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

**Table 9-4.** Livermore site surveillance well W-017

Constituents of concern	Sampling dates		
	3/14/00	8/1/00	10/9/00
Inorganic (µg/L)			
pH (pH units)	na ^(a)	na	7.5
Field pH (pH units)	na	na	7.2
Specific conductance (µS/cm)	na	na	1000
Field specific conductance (µS/cm)	na	na	980
Total dissolved solids (TDS)	na	na	570
Water temperature (°C)	na	na	20.3
Aluminum	na	na	<50
Copper	na	na	<10
Chromium(VI)	na	6.3	9.7
Iron	na	na	<50
Manganese	na	na	<10
Nickel	na	na	<50
Zinc	na	na	<50
General minerals (mg/L)			
Bicarbonate alkalinity (as CaCO ₃)	na	na	190
Calcium	na	na	69
Carbonate alkalinity (as CaCO ₃)	na	na	<10
Chloride	na	na	190
Fluoride	na	na	0.4
Hydroxide alkalinity (as CaCO ₃)	na	na	<10
Magnesium	na	na	52
Nitrate (as N)	na	na	2.1
Nitrate (as NO ₃)	na	9.0	9.3
Nitrate plus nitrite (as N)	na	na	2.1
Nitrite (as N)	na	na	<0.02
Orthophosphate	na	na	0.16
Potassium	na	na	1.9
Sodium	na	na	62
Sulfate	na	na	50
Surfactants	na	na	<0.5
Total alkalinity (as CaCO ₃)	na	na	190
Total hardness (as CaCO ₃)	na	na	390
Total phosphorus (as P)	na	na	0.07
Organic (µg/L)			
EPA Method E547	na	nd ^(b)	na
EPA Method E632	na	nd	na

Table 9-4. Livermore site surveillance well W-017 (concluded)

Constituents of concern	Sampling dates		
	3/14/00	8/1/00	10/9/00
Radioactive (Bq/L)			
Americium-241	0.001 ± 0.003	na	na
Plutonium-238	-0.0003 ± 0.0004	na	0.0003 ± 0.001
Plutonium-239+240	0.0003 ± 0.001	na	0.0002 ± 0.001
Radium-226	0.11 ± 0.04	0.061 ± 0.014	0.018 ± 0.005
Radium-228	0.021 ± 0.014	na	na
Tritium	-0.58 ± 1.4	0.41 ± 2.1	-1.0 ± 2.3

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

**Table 9-5.** Livermore site surveillance well 14B1

Constituents of concern	Sampling dates		
	3/14/00	5/11/00	7/31/00
Inorganic ($\mu\text{g/L}$)			
pH (pH units)	na ^(a)	7.7	na
Specific conductance ($\mu\text{S/cm}$)	na	750	na
Total dissolved solids (TDS)	na	470	na
Aluminum	<50	<50	na
Antimony	<4	na	na
Arsenic	<2	na	na
Barium	120	na	na
Beryllium	<0.2	na	na
Cadmium	<0.5	na	na
Chromium	8.5	na	na
Cobalt	<50	na	na
Copper	<1	10	na
Chromium(VI)	11	na	14
Iron	<50	<50	na
Lead	<5	na	na
Manganese	<10	<10	na
Mercury	<0.2	na	na
Molybdenum	<25	na	na
Nickel	<2	<50	na
Selenium	<2	na	na
Silver	<1	na	na
Thallium	<1	na	na
Vanadium	<10	na	na
Zinc	580	100	na
General minerals (mg/L)			
Bicarbonate alkalinity (as CaCO_3)	na	240	na
Boron	0.69	na	na
Calcium	na	61	na
Chloride	na	76	na
Fluoride	na	0.22	na
Magnesium	na	33	na
Nitrate	29	31	31
Orthophosphate	na	0.22	na
Potassium	na	2.2	na
Sodium	na	67	na
Sulfate	na	43	na



Table 9-5. Livermore site surveillance well 14B1 (concluded)

Constituents of concern	Sampling dates		
	3/14/00	5/11/00	7/31/00
General minerals (mg/L) (continued)			
Surfactants	na	<0.5	na
Total hardness (as CaCO ₃)	na	290	na
Total phosphorus (as P)	na	0.09	na
Organic (µg/L)			
EPA Method 525.2	nd ^(b)	nd	na
EPA Method 547	na	na	nd
EPA Method 632	na	na	nd
EPA Method 8140	nd	nd	na
Radioactive (Bq/L)			
Gross alpha	0.095 ± 0.035	0.14 ± 0.07	na
Gross beta	0.064 ± 0.035	0.13 ± 0.05	na
Plutonium-238	-0.0003 ± 0.0004	na	na
Plutonium-239+240	0.0002 ± 0.0004	<0.004	<0.004
Radium-226	0.084 ± 0.037	0.034 ± 0.25	0.033± 0.012
Radium-228	0.013 ± 0.013	na	na
Tritium	2.3 ± 1.5	4.6 ± 2.2	<3.7± 1.8
Uranium (total)	0.065 ± 0.015	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

**Table 9-6.** Livermore site surveillance well W-121

Constituents of concern	Sampling dates		
	2/28/00	5/9/00	7/25/00
Inorganic ($\mu\text{g/L}$)			
pH (pH units)	na ^(a)	8.2	na
Field pH (pH units)	7.8	7.8	7.7
Specific conductance ($\mu\text{S}/\text{cm}$)	na	700.	na
Field specific conductance ($\mu\text{S}/\text{cm}$)	640	650	670
Total dissolved solids (TDS)	na	430	na
Water temperature ($^{\circ}\text{C}$)	19.2	19.7	21.1
Aluminum	<50	<50	na
Antimony	<4	na	na
Arsenic	<2	na	na
Barium	62	na	na
Beryllium	<0.2	na	na
Cadmium	<0.5	na	na
Chromium	11	na	na
Cobalt	<50	na	na
Copper	<1.	20	na
Chromium(VI)	9.2	na	10
Iron	<50	<50	na
Lead	<5	na	na
Manganese	<10	<10	na
Mercury	<0.2	na	na
Molybdenum	<25	na	na
Nickel	<2	<50	na
Selenium	<2	na	na
Silver	<2	na	na
Thallium	<1	na	na
Vanadium	<10	na	na
Zinc	<20	<50	na
General minerals (mg/L)			
Bicarbonate alkalinity (as CaCO_3)	na	190	na
Boron	0.81	na	na
Calcium	na	40	na
Chloride	na	75	na
Fluoride	na	0.29	na
Magnesium	na	30	na
Nitrate	29	28	28
Orthophosphate	na	0.22	na



Table 9-6. Livermore site surveillance well W-121 (concluded)

Constituents of concern	Sampling dates		
	2/28/00	5/9/00	7/25/00
General minerals (mg/L) (continued)			
Potassium	na	1.9	na
Sodium	na	65	na
Sulfate	na	38	na
Surfactants	na	<0.5	na
Total hardness (as CaCO ₃)	na	220	na
Total phosphorus (as P)	na	0.08	na
Organic (µg/L)			
EPA Method 525.2	nd ^(b)	nd	na
EPA Method E547	na	na	nd
EPA Method 632	na	na	nd
EPA Method 8140	nd	nd	na
Radioactive (Bq/L)			
Gross alpha	0.039 ± 0.031	0.036 ± 0.017	na
Gross beta	0.12 ± 0.06	0.073 ± 0.024	na
Plutonium-238	<0.037	na	na
Plutonium-239+240	<0.037	na	na
Radium-226	0.033 ± 0.013	0.026 ± 0.024	0.097 ± 0.018
Radium-228	0.004 ± 0.020	na	na
Tritium	-1.6 ± 1.4	0.3 ± 2.0	-0.2 ± 2.1
Uranium (total)	0.024 ± 0.008	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

**Table 9-7.** Livermore site surveillance well W-151

Constituents of concern	Sampling dates		
	2/28/00	5/9/00	7/25/00
Inorganic ($\mu\text{g/L}$)			
pH (pH units)	na ^(a)	8	na
Field pH (pH units)	7.5	7.5	7.4
Specific conductance ($\mu\text{S}/\text{cm}$)	na	840	na
Field specific conductance ($\mu\text{S}/\text{cm}$)	756	760	770
Total dissolved solids (TDS)	na	530	na
Water temperature ($^{\circ}\text{C}$)	18.6	18.9	19.2
Aluminum	<50	<50	na
Antimony	<4	na	na
Arsenic	<2	na	na
Barium	81	na	na
Beryllium	<0.2	na	na
Cadmium	<0.5	na	na
Chromium	16	na	na
Cobalt	<50	na	na
Copper	<1	20	na
Chromium(VI)	14	na	15
Iron	<50	<50	na
Lead	<5	na	na
Manganese	<10	<10	na
Mercury	<0.2	na	na
Molybdenum	<25	na	na
Nickel	<2	<50	na
Selenium	<2	na	na
Silver	<2	na	na
Thallium	<1	na	na
Vanadium	<10	na	na
Zinc	<20	<50	na
General minerals (mg/L)			
Bicarbonate alkalinity (as CaCO_3)	na	250	na
Boron	0.67	na	na
Calcium	na	57	na
Chloride	na	86	na
Fluoride	na	0.28	na
Magnesium	na	39	na
Nitrate	37	37	37
Orthophosphate	na	0.23	na

Table 9-7. Livermore site surveillance well W-151 (concluded)

Constituents of concern	Sampling dates		
	2/28/00	5/9/00	7/25/00
General minerals (mg/L) (continued)			
Potassium	na	2	na
Sodium	na	68	na
Sulfate	na	40	na
Surfactants	na	<0.5	na
Total hardness (as CaCO ₃)	na	300	na
Total phosphorus (as P)	na	0.08	na
Organic (µg/L)			
EPA Method 525.2	nd ^(b)	nd	na
EPA Method 547	na	na	nd
EPA Method 632	na	na	nd
EPA Method 8140	nd	nd	na
Radioactive (Bq/L)			
Gross alpha	0.020 ± 0.041	0.081 ± 0.021	na
Gross beta	0.081 ± 0.053	0.070 ± 0.026	na
Plutonium-238	0.0004 ± 0.001	na	na
Plutonium-239+240	-0.0003 ± 0.001	na	na
Radium-226	0.035 ± 0.012	0.036 ± 0.021	0.0467 ± 0.013
Radium-228	-0.004 ± 0.019	na	na
Tritium	0.42 ± 1.5	2.7 ± 2.1	3.8 ± 2.3
Uranium (total)	0.063 ± 0.012	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

**Table 9-8.** Livermore site surveillance well W-571

Constituents of concern	Sampling dates			
	2/28/00	5/9/00	7/25/00	10/19/00
Inorganic (µg/L)				
pH (pH units)	na ^(a)	7.85	na	na
Field pH (pH units)	7.32	7.34	7.24	7.1
Specific conductance (µS/cm)	na	810	na	na
Field specific conductance (µS/cm)	737	743	750	757
Total dissolved solids (TDS)	na	507	na	na
Water temperature (°C)	18.3	18.6	18.8	19
Aluminum	<50	<50	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	100	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	22	na	na	na
Cobalt	<50	na	na	na
Copper	<1	30	na	na
Chromium(VI)	18	na	20	na
Iron	<50	<50	na	na
Lead	<5	na	na	na
Manganese	<10	<10	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	<2	<50	na	na
Selenium	<2	na	na	na
Silver	<2	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<20	<50	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as CaCO ₃)	na	240	na	na
Boron	0.69	na	na	na
Calcium	na	68	na	na
Chloride	na	87	na	na
Fluoride	na	0.31	na	na
Magnesium	na	26	na	na
Nitrate	37	34	36	36

Table 9-8. Livermore site surveillance well W-571 (concluded)

Constituents of concern	Sampling dates			
	2/28/00	5/9/00	7/25/00	10/19/00
General minerals (mg/L) (cont'd)				
Orthophosphate	na	0.19	na	na
Potassium	na	2.4	na	na
Sodium	na	69	na	na
Sulfate	na	31	na	na
Surfactants	na	<0.5	na	na
Total hardness (as CaCO ₃)	na	280	na	na
Total phosphorus (as P)	na	0.08	na	na
Organic (µg/L)				
EPA Method 525.2	nd ^(b)	nd	na	na
EPA Method 547	na	na	nd	na
EPA Method 632	na	na	nd	na
EPA Method 8140	nd	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.20 ± 0.06	0.16 ± 0.08	na	na
Gross beta	0.19 ± 0.06	0.15 ± 0.05	na	na
Plutonium-238	<0.037	na	na	na
Plutonium-239+240	<0.037	na	-0.001 ± 0.001	na
Radium-226	0.006 ± 0.007	0.019 ± 0.020	0.020 ± 0.018	na
Radium-228	0.003 ± 0.016	na	na	na
Tritium	1.9 ± 1.5	1.7 ± 2.1	-2.2 ± 1.8	na
Uranium (total)	0.100 ± 0.016	na	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

**Table 9-9.** Livermore site surveillance well W-1012

Constituents of concern	Sampling dates			
	3/6/00	5/10/00	7/21/00	10/25/00
Inorganic (µg/L)				
pH (pH units)	na ^(a)	7.65	na	na
Field pH (pH units)	na	7.21	7.05	7.07
Specific conductance (µS/cm)	na	1040	na	na
Field specific conductance (µS/cm)	na	1010	989	926
Total dissolved solids (TDS)	na	660	na	na
Water temperature (°C)	na	18.9	19.2	19.1
Aluminum	<50	<50	na	na
Antimony	<4	na	na	na
Arsenic	<2	na	na	na
Barium	130	na	na	na
Beryllium	<0.2	na	na	na
Cadmium	<0.5	na	na	na
Chromium	17	na	na	na
Cobalt	<50	na	na	na
Copper	<1	<10	na	na
Chromium(VI)	17	na	18	na
Iron	<50	<50	na	na
Lead	<5	na	na	na
Manganese	<10	<10	na	na
Mercury	<0.2	na	na	na
Molybdenum	<25	na	na	na
Nickel	2	<50	na	na
Selenium	<2	na	na	na
Silver	<1	na	na	na
Thallium	<1	na	na	na
Vanadium	<10	na	na	na
Zinc	<20	<50	na	na
General minerals (mg/L)				
Bicarbonate alkalinity (as CaCO ₃)	na	280	na	na
Boron	0.58	na	na	na
Calcium	na	110	na	na
Chloride	na	150	na	na
Fluoride	na	0.23	na	na
Magnesium	na	38	na	na
Nitrate	96	97	83	66

Table 9-9. Livermore site surveillance well W-1012 (concluded)

Constituents of concern	Sampling dates			
	3/6/00	5/10/00	7/21/00	10/25/00
General minerals (mg/L) (cont'd)				
Nitrite (as N) ^(b)	na	430	na	na
Orthophosphate	na	0.14	na	na
Potassium	na	2.8	na	na
Sodium	na	80	na	na
Sulfate	na	26	na	na
Surfactants	na	<0.5	na	na
Total hardness (as CaCO ₃)	na	430	na	na
Total phosphorus (as P)	na	0.06	na	na
Organic (µg/L)				
EPA Method 525.2	nd ^(c)	nd	na	na
EPA Method 547	na	na	nd	na
EPA Method 632	na	na	nd	na
EPA Method 8140	nd	nd	na	na
Radioactive (Bq/L)				
Gross alpha	0.054 ± 0.035	0.15 ± 0.04	na	na
Gross beta	0.12 ± 0.041	0.16 ± 0.05	na	na
Plutonium-239+240	<0.004	na	na	na
Radium-226	0.016 ± 0.012	na	0.49 ± 0.034	0.003 ± 0.004
Radium-228	-0.009 ± 0.013	na	na	na
Tritium	-2.5 ± 2.1	-0.31 ± 2.0	-0.135 ± 2.131	na
Uranium (total)	0.109 ± 0.012	na	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b This is the only surveillance monitoring well in which nitrite was detected in a groundwater sample.

c nd = None detected above reporting limits

**Table 9-10. Livermore site surveillance well W-556**

Constituents of concern	Sampling dates		
	2/9/00	5/11/00	7/31/00
Inorganic (µg/L)			
pH (pH units)	na ^(a)	7.7	na
Field pH (pH units)	7.6	7.4	7.2
Specific conductance (µS/cm)	na	880	na
Field specific conductance (µS/cm)	1000	840	890
Total dissolved solids (TDS)	na	560	na
Field temperature (°C)	18.3	18.2	18.8
Aluminum	<50	<50	na
Antimony	<4	na	na
Arsenic	<2	na	na
Barium	88	na	na
Beryllium	<0.2	na	na
Cadmium	<0.5	na	na
Chromium	30	na	na
Cobalt	<50	na	na
Copper	<1	<10	na
Chromium(VI)	26	na	26
Iron	<50	<50	na
Lead	<5	na	na
Manganese	<10	<10	na
Mercury	<0.2	na	na
Molybdenum	<25	na	na
Nickel	<2	<50	na
Selenium	3	na	na
Silver	<1	na	na
Thallium	<4	na	na
Vanadium	<10	na	na
Zinc	<20	<50	na
General minerals (mg/L)			
Bicarbonate alkalinity (as CaCO ₃)	na	230	na
Boron	0.99	na	na
Calcium	na	68	na
Chloride	na	130	na
Fluoride	na	0.28	na
Magnesium	na	24	na
Nitrate	31	35	31
Orthophosphate	na	0.17	na

Table 9-10. Livermore site surveillance well W-556 (concluded)

Constituents of concern	Sampling dates		
	2/9/00	5/11/00	7/31/00
General minerals (mg/L) (continued)			
Potassium	na	1.7	na
Sodium	na	100	na
Sulfate	na	36	na
Surfactants	na	<0.5	na
Total hardness (as CaCO ₃)	na	270	na
Total phosphorus (as P)	na	0.06	na
Organic (µg/L)			
EPA Method 525.2	nd ^(b)	nd	na
EPA Method 547	na	na	nd
EPA Method 632	na	na	nd
EPA Method 8140	nd	nd	na
Radioactive (Bq/L)			
Gross alpha	0.050 ± 0.059	0.094 ± 0.057	na
Gross beta	0.037 ± 0.088	0.085 ± 0.053	na
Plutonium-239+240	-0.0001 ± 0.0004	0.0002 ± 0.001	na
Radium-226	0.042 ± 0.035	0.023 ± 0.023	0.042 ± 0.014
Radium-228	0.019 ± 0.019	na	na
Tritium	-0.6 ± 2.0	3.0 ± 2.1	2.7 ± 2.2
Uranium (total)	0.10 ± 0.017	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

**Table 9-11. Livermore site surveillance well W-373**

Constituents of concern	Sampling dates		
	2/9/00	5/11/00	7/31/00
Inorganic ($\mu\text{g/L}$)			
pH (pH units)	na ^(a)	7.7	na
Field pH (pH units)	7.6	7.4	7.2
Specific conductance ($\mu\text{S/cm}$)	na	860	na
Field specific conductance ($\mu\text{S/cm}$)	930	820	820
Total dissolved solids (TDS, mg/L)	na	540	na
Field temperature ($^{\circ}\text{C}$)	18.5	18.5	18.7
Aluminum	<50	<0.05	na
Antimony	<4	na	na
Arsenic	<2	na	na
Barium	50	na	na
Beryllium	<0.2	na	na
Cadmium	<0.5	na	na
Chromium	53	na	na
Cobalt	<50	na	na
Copper	<1	<10	na
Chromium(VI)	58	na	50
Iron	<50	<50	na
Lead	<5	na	na
Manganese	<10	<10	na
Mercury	<0.2	na	na
Molybdenum	<25	na	na
Nickel	<2	<50	na
Selenium	<2	na	na
Silver	<1	na	na
Thallium	<4	na	na
Vanadium	<10	na	na
Zinc	<20	<50	na
General minerals (mg/L)			
Bicarbonate alkalinity (as CaCO_3)	na	210	na
Boron	1.8	na	na
Calcium	na	57	na
Chloride	na	120	na
Fluoride	na	0.42	na
Magnesium	na	20	na
Nitrate	12	13	13
Orthophosphate	na	0.12	na

Table 9-11. Livermore site surveillance well W-373 (concluded)

Constituents of concern	Sampling dates		
	2/9/00	5/11/00	7/31/00
General minerals (mg/L) (continued)			
Potassium	na	1.5	na
Sodium	na	110	na
Sulfate	na	64	na
Surfactants	na	<0.5	na
Total hardness (as CaCO ₃)	na	220	na
Total phosphorus (as P)	na	<0.05	na
Organic (µg/L)			
EPA Method 525.2	nd ^(b)	nd	na
EPA Method 547	na	na	nd
EPA Method 632	na	na	nd
EPA Method 8140	nd	nd	na
Radioactive (Bq/L)			
Gross alpha	-0.039 ± 0.064	0.12 ± 0.04	na
Gross beta	0.058 ± 0.085	0.077 ± 0.043	na
Plutonium-239+240	0.004 ± 0.001	0.0004 ± 0.0012	<0.004
Radium-226	0.018 ± 0.025	0.034 ± 0.027	0.016 ± 0.007
Radium-228	0.009 ± 0.016	na	na
Tritium	12 ± 2.5	11 ± 2.4	13 ± 2.6
Uranium (total)	0.080 ± 0.021	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

**Table 9-12.** Livermore site surveillance well W-204

Constituents of concern	Sampling dates		
	3/20/00	5/30/00	8/2/00
Inorganic ($\mu\text{g/L}$)			
Copper	<10	na ^(a)	na
Lead	<5	na	na
Zinc	<10	na	na
Organic ($\mu\text{g/L}$)			
EPA Method 8082	na	na	nd ^(b)
Radioactive (Bq/L)			
Radium-226	0.043 ± 0.022	na	na
Radium-228	0.009 ± 0.015	na	na
Tritium	-1.4 ± 2.0	0.53 ± 1.7	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected by above reporting limits

Table 9-13. Livermore site surveillance well W-363

Constituents of concern	Sampling dates			
	3/20/00	5/30/00	8/2/00	11/14/00
Inorganic ($\mu\text{g/L}$)				
Copper	<10	na ^(a)	na	na
Lead	<5	na	na	na
Zinc	<10	na	na	na
Organic ($\mu\text{g/L}$)				
EPA Method 8082	na	na	nd ^(b)	na
Radioactive (Bq/L)				
Radium-226	0.017 ± 0.013	na	na	na
Radium-228	0.019 ± 0.016	na	na	na
Tritium	160 ± 5.7	64 ± 7.0	na	72 ± 8.9

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits



Table 9-14. Livermore site surveillance well W-1308

Constituents of concern	Sampling dates			
	2/29/00	4/25/00	7/26/00	10/12/00
Inorganic ($\mu\text{g/L}$)				
Copper	<10	na ^(a)	na	na
Lead	<5	na	na	na
Zinc	<10	na	na	na
Organic ($\mu\text{g/L}$)				
EPA Method 8082	na	na	nd ^(b)	na
Radioactive (Bq/L)				
Americium-241	0.0003 ± 0.002	na	na	na
Plutonium-238	0.0004 ± 0.0008	na	na	na
Plutonium-239+240	0.0001 ± 0.001	na	na	na
Radium-226	0.088 ± 0.033	na	na	na
Radium-228	0.012 ± 0.016	na	na	na
Tritium	20 ± 2.3	na	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

**Table 9-15.** Livermore site surveillance well W-1303

Constituents of concern	Sampling dates			
	2/29/00	4/14/00	7/26/00	10/25/00
Inorganic ($\mu\text{g/L}$)				
Copper	<10	na ^(a)	na	na
Lead	<5	na	na	na
Zinc	<10	na	na	na
General minerals (mg/L)				
Nitrate	na	na	na	42
Organic ($\mu\text{g/L}$)				
EPA Method 8082	na	na	nd ^(b)	na
Radioactive (Bq/L)				
Americium-241	0.004 ± 0.004	na	na	0.0013 ± 0.0011
Plutonium-238	-0.001 ± 0.001	na	na	na
Plutonium-239+240	0.0001 ± 0.001	na	na	na
Radium-226	0.027 ± 0.021	na	na	na
Radium-228	0.014 ± 0.015	na	na	na
Tritium	29 ± 2.6	na	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

Table 9-16. Livermore site surveillance well W-119

Constituents of concern	Sampling dates	
	3/6/00	8/1/00
Inorganic ($\mu\text{g/L}$)		
Copper	<10	na ^(a)
Lead	<5	na
Zinc	<10	na
Organic ($\mu\text{g/L}$)		
EPA Method 8082	na	nd ^(b)
Radioactive (Bq/L)		
Americium-241	0.0002 ± 0.0005	na
Plutonium-238	-0.0001 ± 0.0002	na
Radium-226	0.11 ± 0.03	na
Radium-228	0.006 ± 0.018	na
Tritium	23 ± 3.0	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

Table 9-17. Livermore site surveillance well W-1306

Constituents of concern	Sampling dates	
	2/29/00	7/27/00
Inorganic ($\mu\text{g/L}$)		
Copper	<10	na ^(a)
Lead	<5	na
Zinc	<10	na
Organic ($\mu\text{g/L}$)		
EPA Method 8082	na	nd ^(b)
Radioactive (Bq/L)		
Americium-241	-0.00002 ± 0.005	na
Plutonium-238	0.0004 ± 0.0008	na
Plutonium-239+240	0.0004 ± 0.0008	na
Radium-226	0.12 ± 0.042	na
Radium-228	0.026 ± 0.017	na
Tritium	11 ± 2.0	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

**Table 9-18.** Livermore site surveillance well W-906

Constituents of concern	Sampling dates		
	3/6/00	7/26/00	10/10/00
Inorganic ($\mu\text{g/L}$)			
Copper	<10	na ^(a)	na
Lead	<5	na	na
Zinc	17	na	na
Organic ($\mu\text{g/L}$)			
EPA Method 8082	na	nd ^(b)	na
Radioactive (Bq/L)			
Americium-241	0.0008 \pm 0.001	na	na
Plutonium-239+240	0.0005 \pm 0.0009	na	na
Radium-226	0.020 \pm 0.012	na	0.0057 \pm 0.0044
Radium-228	0.010 \pm 0.012	na	na
Tritium	1.3 \pm 2.2	na	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

Table 9-19. Livermore site surveillance well W-593

Constituents of concern	Sampling date
	3/13/00
Inorganic ($\mu\text{g/L}$)	
Field pH (pH units)	7.3
Field specific conductance ($\mu\text{S/cm}$)	2100
Field temperature ($^{\circ}\text{C}$)	19.8
Copper	<10
Lead	<5
Zinc	<10
Radioactive (Bq/L)	
Americium-241	0.00036 \pm 0.00070
Plutonium-239+240	0.00001 \pm 0.00057
Radium-226	0.10 \pm 0.039
Radium-228	0.016 \pm 0.016
Tritium	-1.7 \pm 2.1

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

Table 9-20. Livermore site surveillance well W-270

Constituents of concern	Sampling date
	10/19/00
Inorganic (µg/L)	
pH (pH units)	7.60
Specific conductance (µS/cm)	2100
Total dissolved solids (TDS)	1800
Aluminum	<50
Copper	<10
Chromium(VI)	9.4
Iron	<50
Manganese	39
Nickel	<50
Zinc	<50
General minerals (mg/L)	
Total alkalinity (as CaCO ₃)	350
Calcium	370
Chloride	48
Fluoride	0.48
Nitrate (as N)	0.51
Nitrite (as N)	<0.02
Orthophosphate	0.11
Potassium	2.7
Sodium	78
Sulfate	960
Surfactants	<0.5
Total hardness (as CaCO ₃)	1200
Total phosphorus (as P)	0.05
Radioactive (Bq/L)	
Radium-226	0.0011 ± 0.0036
Tritium	2.1 ± 2.0
Plutonium-238	0.0003 ± 0.0009
Plutonium-239+240	0.0001 ± 0.0005

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

**Table 9-21.** Livermore site surveillance well W-359

Constituents of concern	Sampling dates		
	3/13/00	8/1/00	10/18/00
Inorganic ($\mu\text{g/L}$)			
pH (pH units)	na ^(a)	na	7.8
Field pH (pH units)	7.4	na	7.3
Specific conductance ($\mu\text{S/cm}$)	na	na	560
Field specific conductance ($\mu\text{S/cm}$)	510	na	520
Total dissolved solids (TDS, mg/L)	na	na	330
Field temperature ($^{\circ}\text{C}$)	19.8	na	20.3
Aluminum	na	na	<50
Chromium(VI)	na	na	6.6
Copper	na	na	10
Iron	na	na	<50
Manganese	na	na	<10
Nickel	na	na	<50
Zinc	na	na	<50
General minerals (mg/L)			
Bicarbonate alkalinity (as CaCO_3)	na	na	150
Calcium	na	na	41
Chloride	na	na	66
Fluoride	na	na	0.36
Magnesium	na	na	19
Nitrate	na	na	20
Orthophosphate	na	na	0.14
Potassium	na	na	1.5
Sodium	na	na	49
Sulfate	na	na	16
Surfactants	na	na	<0.5
Total hardness (as CaCO_3)	na	na	180
Total phosphorus (as P)	na	na	0.05
Radioactive (Bq/L)			
Americium-241	0.0016 ± 0.0012	na	na
Plutonium-238	0.0002 ± 0.0004	<0.0037	0.002 ± 0.001
Plutonium-239+240	0.0005 ± 0.0008	<0.0037	<0.0037
Radium-226	0.12 ± 0.04	na	0.006 ± 0.004
Radium-228	0.035 ± 0.031	na	na
Tritium	3.9 ± 2.3	na	5.5 ± 2.1

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

Table 9-22. Livermore site surveillance well GSW-011

Constituents of concern	Sampling dates	
	3/13/00	10/19/00
Inorganic ($\mu\text{g/L}$)		
pH (pH units)	na ^(a)	7.6
Specific conductance ($\mu\text{S}/\text{cm}$)	na	890
Field temperature ($^{\circ}\text{C}$)	20.8	21.3
Field specific conductance ($\mu\text{S}/\text{cm}$)	880	850
Field pH (pH units)	7.1	7
Total dissolved solids (TDS, mg/L)	na	520
Aluminum	na	<50
Chromium(VI)	na	13
Copper	na	20
Iron	na	<50
Manganese	na	700
Nickel	na	<50
Zinc	na	<50
General minerals (mg/L)		
Bicarbonate alkalinity (as CaCO_3)	na	400
Carbonate alkalinity (as CaCO_3)	na	<5
Chloride	na	50
Hydroxide alkalinity (as CaCO_3)	na	<5
Nitrate (as N)	na	5.5
Nitrite (as N)	na	<0.02
Orthophosphate	na	0.16
Potassium	na	2.6
Sodium	na	74
Sulfate	na	15
Total alkalinity (as CaCO_3)	na	400
Total hardness (as CaCO_3)	na	330
Total phosphorus (as P)	na	0.06
Radioactive (Bq/L)		
Americium-241	0.0011 ± 0.0016	na
Plutonium-238	0.00003 ± 0.0009	0.0009 ± 0.0009
Plutonium-239+240	0.0006 ± 0.0019	0.0004 ± 0.0007
Radium-226	0.070 ± 0.032	0.002 ± 0.003
Radium-228	-0.002 ± 0.018	na
Tritium	3.8 ± 2.3	4.3 ± 2.1

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

**Table 9-23. Livermore site surveillance well W-307**

Constituents of concern	Sampling dates	
	3/16/00	8/3/00
Inorganic ($\mu\text{g/L}$)		
Aluminum	<50	na ^(a)
Antimony	<4	na
Arsenic	<2	na
Barium	290	na
Beryllium	<0.2	na
Boron	700	na
Cadmium	<1	na
Chromium	13	na
Cobalt	<50	na
Copper	4	na
Chromium(VI)	13	14
Iron	<50	na
Lead	<5	na
Manganese	<10	na
Mercury	<0.2	na
Molybdenum	<25	na
Nickel	<2	na
Selenium	<2	na
Silver	<1	na
Thallium	<1	na
Vanadium	<10	na
Zinc	<20	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

Table 9-24. Livermore site surveillance well W-226

Constituents of concern	Sampling dates	
	3/16/00	8/3/00
Inorganic ($\mu\text{g/L}$)		
Aluminum	<50	na ^(a)
Antimony	<4	na
Arsenic	<2	na
Barium	150	na
Beryllium	<0.2	na
Boron	560	na
Cadmium	<1	na
Chromium	9	na
Cobalt	<50	na
Copper	2	na
Chromium(VI)	26	27
Iron	<50	na
Lead	<5	na
Manganese	<10	na
Mercury	<0.2	na
Molybdenum	<25	na
Nickel	<2	na
Selenium	<2	na
Silver	<1	na
Thallium	<1	na
Vanadium	<10	na
Zinc	<20	na

a na = Not analyzed (analysis not required)

**Table 9-25.** Livermore site surveillance well W-306

Constituents of concern	Sampling dates	
	3/16/00	8/3/00
Inorganic ($\mu\text{g/L}$)		
Field pH (pH units)	7.3	na ^(a)
Field specific conductance ($\mu\text{S/cm}$)	790	na
Field temperature ($^{\circ}\text{C}$)	20.3	na
Aluminum	<50	na
Antimony	<4	na
Arsenic	<2	na
Barium	95	na
Beryllium	<0.2	na
Boron	1300	na
Cadmium	<1	na
Chromium	10	na
Cobalt	<50	na
Copper	41	na
Chromium(VI)	40	41
Iron	<50	na
Lead	<5	na
Manganese	<10	na
Mercury	<0.2	na
Molybdenum	<25	na
Nickel	<2	na
Selenium	<2	na
Silver	<1	na
Thallium	<1	na
Vanadium	<10	na
Zinc	<20	na

a na = Not analyzed (analysis not required)

Table 9-26. Livermore site surveillance well W-305

Constituents of concern	Sampling dates		
	3/14/00	8/3/00	10/11/00
Inorganic ($\mu\text{g/L}$)			
Field pH (pH units)	na ^(a)	na	7.3
Field specific conductance ($\mu\text{S/cm}$)	na	na	620
Field temperature ($^{\circ}\text{C}$)	na	na	19.6
Radioactive (Bq/L)			
Americium-241	0.0009 \pm 0.0009	na	na
Plutonium-238	-0.0002 \pm 0.0003	<0.0037	na
Plutonium-239+240	0.0007 \pm 0.0009	<0.0037	na
Radium-226	0.023 \pm 0.024	na	na
Radium-228	0.058 \pm 0.017	na	na
Tritium	4.2 \pm 1.7	na	5.4 \pm 2.5

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

Table 9-27. Livermore site surveillance well SIP-331-001

Constituents of concern	Sampling dates	
	3/15/00	11/16/00
Radioactive (Bq/L)		
Gross alpha	na ^(a)	0.043 \pm 0.078
Gross beta	na	0.11 \pm 0.07
Americium-241	0.0007 \pm 0.0011	na
Plutonium-238	0.0002 \pm 0.0004	na
Plutonium-239+240	0.0001 \pm 0.0005	na
Radium-226	0.054 \pm 0.028	na
Radium-228	0.057 \pm 0.013	na
Tritium	19 \pm 2.2	21 \pm 3.5

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

**Table 9-28.** Livermore site surveillance well W-148

Constituents of concern	Sampling dates				
	3/15/00	8/3/00	10/24/00	11/16/00	12/14/00
Inorganic ($\mu\text{g/L}$)					
Field pH (pH units)	na ^(a)	na	7.4	8.1	7.4
Field specific conductance ($\mu\text{S}/\text{cm}$)	na	na	460	150	200
Field temperature ($^{\circ}\text{C}$)	na	na	20.2	16.2	18.2
Chromium(VI)	na	<0.002	na	na	na
Nitrate (as NO_3)	na	38	na	na	na
Organic ($\mu\text{g/L}$)					
EPA Method 547	na	nd ^(b)	na	na	na
EPA Method 632	na	nd	na	na	na
Radioactive (Bq/L)					
Americium-241	0.0001 ± 0.0005	na	na	na	na
Plutonium-238	-0.0002 ± 0.0003	na	-0.0004 ± 0.0007	na	na
Plutonium-239+240	-0.0001 ± 0.0002	-0.0002 ± 0.0004	-0.0004 ± 0.0005	na	na
Radium-226	0.30 ± 0.07	0.048 ± 0.015	0.008 ± 0.004	na	na
Radium-228	0.02 ± 0.01	na	na	na	na
Tritium	1.9 ± 1.5	115 ± 5	33 ± 4.8	11 ± 2.8	6.1 ± 2.1

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

Table 9-29. Tritium activities in selected Livermore site surveillance wells, 2000

Location	Screened in HSU	Sampling date	Tritium activity (Bq/L)
Upgradient from Tritium Facility (B331)			
W-276	3A/3B	10/10	0.78 ± 2.4
W-277	3B	10/10	6.4 ± 2.6
W-292	3B	10/11	4.3 ± 2.4
W-305 ^(a)	2	3/15	4.2 ± 1.7
		10/12	5.4 ± 2.5
W-353	2	10/11	17 ± 3.1
Downgradient from Tritium Facility (B331)			
W-101	1B	10/18	11 ± 2.4
		11/16	9.2 ± 2.7
		12/14	8.6 ± 2.3
W-147	1B	10/24	31 ± 4.4
W-148 ^(b)	1B	3/15	1.9 ± 1.5
		8/3	115 ± 5.0
		10/24	33 ± 4.8
		11/16	11 ± 2.8
		12/14	6.1 ± 2.1
W-301	2	10/10	6.4 ± 2.7
		11/16	7.8 ± 2.7
		12/14	9.9 ± 2.4
W-618	3B	10/24	-0.27 ± 2.3

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a All 2000 surveillance monitoring data for well W-305 are presented in Table 9-26.

b All 2000 surveillance monitoring data for well W-148 are presented in Table 9-28.

**Table 9-30. Tritium activity in Livermore Valley wells, 2000**

Location	Sampling date	Tritium activity (Bq/L)
11B1	9/26	4.3 ± 2.0
12A2	9/26	1.5 ± 1.9
12D2	9/26	5.0 ± 2.0
12G1	9/26	1.2 ± 1.9
16L5	7/17	-0.1 ± 1.9
16L7	7/17	0.7 ± 1.9
18A6	8/10	-0.5 ± 1.9
1P2	9/26	1.3 ± 1.9
1R2	9/26	1.2 ± 1.9
2R1	9/26	1.7 ± 1.9
7C2	9/26	0.6 ± 1.9
0O4	7/17	1.6 ± 1.9
9B1	8/10	-0.3 ± 1.9
9M2	8/10	0.3 ± 1.9
9M3	8/10	0.6 ± 1.9
16B1	6/22	1.4 ± 1.9
7P3	6/22	0.1 ± 1.9
8F1	6/22	0.5 ± 1.9
8P1	6/22	0.5 ± 1.9
9Q1	6/22	0.1 ± 1.9

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

**Table 9-31. Nitrate concentrations in selected Livermore site surveillance wells, 2000**

Location	Screened in HSU	Sampling date	Nitrate as NO ₃ (mg/L)
W-1012 ^(a)	2	3/6	96
		5/10	97
		7/21	83
		10/25	66
W-571 ^(b)	1B	2/28	37
		5/9	34
		7/25	36
		10/19	36
W-1013	1B	10/17	34
W-1420	2	10/17	37
W-422	2	10/17	27
W-610	1B	10/12	42
W-620	1B	10/12	38
W-621	2	10/12	36
W-654	2	10/10	12
W-705	1B	10/19	28

a All 2000 surveillance monitoring data for well W-1012 are presented in Table 9-9.

b All 2000 surveillance monitoring data for well W-571 are presented in Table 9-8.

**Table 9-32. Site 300, Elk Ravine surveillance wells, 2000**

Constituents of concern	Well						
	K7-07(a)	NC7-61		NC7-69		K2-04D	
	Sampling dates						
	5/18	5/18	11/20	5/17	11/20	5/17	11/21
Inorganic (µg/L)							
Antimony	<5	<5	<5	<5	<5	<5	<5
Arsenic	20	18	17	<2	<2	11	10
Barium	110	88	75	29	<25	37	35
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	4	1	1	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	<10	<10	<10
Lead	3	<2	<2	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	<5	<5
Potassium (mg/L)	2	5	6	6	6	4	4
Selenium	<2	<2	<2	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2	<2	<2	<2
Vanadium	43	85	84	<25	<25	51	51
Zinc	<20	<20	30	<20	<20	<20	<20
Organic (µg/L)							
EPA Method 601	na ^(b)	na	nd ^(c)	na	nd	na	nd
Explosive (µg/L)							
HMX	<1	4	<1	<1	<1	<1	<1
RDX	<1	6	<1	<1	<1	<1	<1
Radioactive (Bq/L)							
Gross alpha	0.09 ± 0.03	0.04 ± 0.02	0.11 ± 0.09	0.01 ± 0.02	-0.02 ± 0.07	0.07 ± 0.03	0.01 ± 0.06
Gross beta	0.11 ± 0.03	0.11 ± 0.03	0.25 ± 0.09	0.18 ± 0.04	0.18 ± 0.08	0.08 ± 0.03	0.05 ± 0.09
Tritium	101 ± 4	2779 ± 21	2509 ± 281	0 ± 1	2 ± 2	147 ± 5	141 ± 16
Uranium (total)	0.211 ± 0.018	0.090 ± 0.009	0.084 ± 0.008	0.003 ± 0.001	0.004 ± 0.001	0.078 ± 0.008	0.091 ± 0.009

Table 9-32. Site 300, Elk Ravine surveillance wells, 2000 (continued)

Constituents of concern	Well							
	K2-04S		K2-01C				NC2-12D	
	Sampling dates							
	5/18	11/27	5/17	6/14	6/22	11/21	5/17	11/27
Inorganic ($\mu\text{g/L}$)								
Antimony	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	18	16	6	8	7	7	12	13
Barium	60	57	39	36	37	32	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	2	2	2	<1	<1	<1
Cobalt	<25	<25	<25	<25	<25	<25	<25	<25
Copper	<10	130	50	40	20	30	<10	<10
Lead	<2	12	14	10	3	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	200	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	7	<5	<5
Potassium (mg/L)	4	4	6			4	5	5
Selenium	<2	<2	<2	<2	<2	2	2	3
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2	<2	<2	<2	<2
Vanadium	67	64	45	<25	50	47	51	50
Zinc	<20	40	240	<20	<20	<20	<20	<20
Organic ($\mu\text{g/L}$)								
EPA Method 601	na	nd	na	na	na	nd	na	nd
Explosive ($\mu\text{g/L}$)								
HMX	<1	<1	<1	na	na	<1	<1	<1
RDX	<1	<1	<1	na	na	<1	<1	<1
Radioactive (Bq/L)								
Gross alpha	0.06 ± 0.03	0.01 ± 0.06	0.19 ± 0.05	na	na	0.17 ± 0.11	0.09 ± 0.03	0.04 ± 0.06
Gross beta	0.11 ± 0.03	0.19 ± 0.07	0.11 ± 0.03	na	na	0.19 ± 0.08	0.14 ± 0.03	0.23 ± 0.07
Tritium	781 ± 11	762 ± 85	618 ± 10	na	na	644 ± 74	360 ± 8	370 ± 41
Uranium (total)	0.124 ± 0.012	0.129 ± 0.011	0.214 ± 0.018	na	na	0.175 ± 0.014	0.113 ± 0.011	0.116 ± 0.011

**Table 9-32. Site 300, Elk Ravine surveillance wells, 2000 (concluded)**

Constituents of concern	Well					
	NC2-11D		SPRING6 (GEOCRK)		NC2-07	
	Sampling dates					
	5/17	11/27	6/20	11/27	5/22	11/28
Inorganic (µg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	12	12	40	27	42	38
Barium	<25	<25	50	42	35	31
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1	1	<1
Cobalt	<25	<25	<25	<25	<25	<25
Copper	<10	<10	<10	<10	<10	<10
Lead	<2	<2	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	<5
Potassium (mg/L)	6	5	5.8	7	7	7
Selenium	2	2	2	3	3	2
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<1	<2	<2	<2
Vanadium	50	46	64	53	48	48
Zinc	<20	<20	<20	<20	<20	<20
Organic (µg/L)						
EPA Method 601	na	nd	nd	nd	na	nd
Explosive (µg/L)						
HMX	<1	<1	<5	<1	<1	<1
RDX	<1	<1	<5	<1	<1	<1
Radioactive (Bq/L)						
Gross alpha	0.08 ± 0.03	0.15 ± 0.09	0.08 ± 0.03	0.08 ± 0.04	0.16 ± 0.06	0.18 ± 0.11
Gross beta	0.20 ± 0.04	0.20 ± 0.07	0.10 ± 0.03	0.31 ± 0.06	0.21 ± 0.04	0.28 ± 0.11
Tritium	134 ± 5	145 ± 17	0.9 ± 2.0	-0.2 ± 2.3	-0.01 ± 2.1	2.2 ± 2.3
Uranium (total)	0.172 ± 0.021	0.186 ± 0.015	0.168 ± 0.015	0.187 ± 0.015	0.265 ± 0.025	0.257 ± 0.021

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a Well was dry during fourth quarter.

b na = Not analyzed (analysis not required)

c nd = None detected above reporting limits

Table 9-33. Site 300, Pit 2 surveillance wells, 2000

Constituents of concern	Well			
	K1-02A		K2-01A	
	Sampling dates			
	5/24	12/7	5/24	12/7
Inorganic ($\mu\text{g/L}$)				
Antimony	<5	<5	<5	<5
Arsenic	17	6	<2	10
Barium	39	33	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	40	<10	60
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Potassium (mg/L)	5	5	7	4
Selenium	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	<25	45	<25	50
Zinc	<20	<20	<20	70
Explosives ($\mu\text{g/L}$)				
HMX	<1	<1	<1	<1
RDX	<1	<1	<1	<1
Radioactive (Bq/L)				
Gross alpha	0.044 ± 0.027	0.15 ± 0.085	0.008 ± 0.020	0.028 ± 0.056
Gross beta	0.13 ± 0.031	0.14 ± 0.085	0.18 ± 0.037	0.12 ± 0.059
Tritium	4.5 ± 2.3	622 ± 70	-0.9 ± 2.1	208 ± 24
Uranium (total)	0.052 ± 0.008	0.176 ± 0.015	0.005 ± 0.002	0.089 ± 0.009

**Table 9-33. Site 300, Pit 2 surveillance wells, 2000 (concluded)**

Constituents of concern	Well			
	K2-02A		K2-02B	
	Sampling dates			
	5/24	12/7	5/24	12/7
Inorganic ($\mu\text{g/L}$)				
Antimony	<5	<5	<5	<5
Arsenic	31	24	<2	<2
Barium	<25	25	26	26
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Potassium (mg/L)	6	6	6	6
Selenium	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Explosives ($\mu\text{g/L}$)				
HMX	<1	<1	<1	<1
RDX	<1	<1	<1	<1
Radioactive (Bq/L)				
Gross alpha	0.051 ± 0.030	0.080 ± 0.067	-0.003 ± 0.018	-0.006 ± 0.052
Gross beta	0.18 ± 0.041	0.11 ± 0.081	0.12 ± 0.036	0.16 ± 0.070
Tritium	-1.5 ± 2.1	0.88 ± 2.29	-1.8 ± 2.1	24 ± 2.3
Uranium (total)	0.079 ± 0.010	0.064 ± 0.007	0.007 ± 0.002	0.002 ± 0.001

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

Table 9-34. Site 300, Pit 8 surveillance wells, 2000

Constituents of concern	Well			
	K8-01		K8-02B	
	Sampling dates	6/1	12/12	6/1
Inorganic ($\mu\text{g/L}$)				
Antimony	<5	<5	<5	<5
Arsenic	20	19	23	23
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	17	14	1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	42	33	31	24
Potassium (mg/L)	6	6	7	7
Selenium	4	3	5	5
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	72	68	68	67
Zinc	<20	<20	<20	<20
Organic ($\mu\text{g/L}$)				
EPA Method 601	nd (exc) ^(a)	nd (exc)	nd (exc)	nd (exc)
1,2-Dichloroethane	3.3	2.1	<0.5	<0.5
Trichloroethene	3.6	3.9	2	1.9
EPA Method 608	na ^(b)	nd ^(c)	na	nd
EPA Method 8082A	na	nd	na	nd
Explosives ($\mu\text{g/L}$)				
HMX	<1	<1	<2	<1
RDX	<1	<1	<2	<1
Radioactive (Bq/L)				
Gross alpha	0.203 ± 0.063	0.173 ± 0.089	0.174 ± 0.052	0.269 ± 0.118
Gross beta	0.259 ± 0.048	0.205 ± 0.081	0.15 ± 0.037	0.307 ± 0.100
Radium-226	0.004 ± 0.003	0.005 ± 0.003	na	na
Tritium	2.8 ± 2.1	-0.3 ± 2.6	-1.2 ± 2.0	1.7 ± 2.4
Uranium (total)	0.28 ± 0.022	0.26 ± 0.022	0.35 ± 0.027	0.34 ± 0.028

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd (exc) = None detected above reporting limits, except for constituents listed below the method.

b na = Not analyzed (analysis not required)

c nd = None detected above reporting limits

**Table 9-35. Site 300, Pit 9 surveillance wells**

Constituents of concern	Well			
	K9-01	K9-02	K9-03	K9-04
	Sampling dates			
	8/28	8/28	8/29	8/29
Inorganic ($\mu\text{g/L}$)				
Antimony	<5	<5	<5	<5
Arsenic	3	20	11	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	25	<25	<25	<25
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	<1	<1	<1	<1
Potassium (mg/L)	17	22	22	19
Selenium	<2	<2	<2	<2
Silver	<0.5	<0.5	<0.5	<0.5
Thallium	<2	<2	<2	<2
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Organic ($\mu\text{g/L}$)				
EPA Method 601	nd ^(a)	nd	nd	nd
Explosives ($\mu\text{g/L}$)				
HMX	<1	<1	<1	<1
RDX	<1	<1	<1	<1
Radioactive (Bq/L)				
Gross alpha	-0.074 ± 0.067	0.022 ± 0.078	-0.006 ± 0.070	-0.080 ± 0.070
Gross beta	0.333 ± 0.104	0.392 ± 0.115	0.481 ± 0.118	0.385 ± 0.107
Tritium	-0.4 ± 2.4	-2.8 ± 2.3	-0.5 ± 2.4	0.4 ± 2.4
Uranium (total)	0.002 ± 0.001	0.012 ± 0.002	0.019 ± 0.003	0.019 ± 0.003

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd = None detected above reporting limits

Table 9-36. Analytical results for Site 300 Building 829 area deep monitoring wells, 2000

Constituents of concern	Sampling dates for W-827-05			
	2/28	5/11	8/23	12/4
Inorganic ($\mu\text{g/L}$)				
pH (pH units)	8.45	7.4	8.59	7.09
Conductivity ($\mu\text{S}/\text{cm}$)	1800	1910	1920	1960
Antimony	<5	<5	<5	<8
Arsenic	<2	<2	<2	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	3	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	20	20	<10
Iron	63	<50	<50	<50
Lead	<2	<2	<2	<2
Manganese	230	180	180	230
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<2	<2
Silver	<2	<0.5	<0.5	<0.5
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Chloride (mg/L)	175	160	160	169
Fluoride (mg/L)	0.19	0.2	0.21	0.22
Nitrate (as NO_3) (mg/L)	<0.4	<0.4	<0.4	<0.4
Sodium (mg/L)	240	260	250	260
Sulfate (mg/L)	591	572	561	584
Organic ($\mu\text{g/L}$)				
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)	<1	<1	<1	<1
Benzene	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	<0.5	<0.5	<0.5
Freon 113	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.5	<0.5	<0.5	<0.5

**Table 9-36. Analytical results for Site 300 Building 829 area deep monitoring wells, 2000 (continued)**

Constituents of concern	Sampling dates for W-827-05			
	2/28	5/11	8/23	12/4
Organic (µg/L) (continued)				
Toluene	<0.5	<0.5	<0.5	<0.5
Total xylene isomers	<1	<1	<1	<1
Trichloroethene	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5
BHC, gamma isomer (Lindane)	na ^(a)	<2	<2	<2
Bis(2-ethylhexyl)phthalate	na	<5	<5	<5
Endrin	na	<2	<2	<2
Phenol	na	<2	<2	<2
Total organic halides (TOX)	na	<20	126	<20
Total organic carbon (TOC) (mg/L)	na	1.1	<1	<1
Total coliform (MPN/100 mL)	<2	<2	<2	<2
Explosives (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
TNT	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	-0.02 ± 0.04	-0.02 ± 0.06	-0.03 ± 0.07	-0.003 ± 0.10
Gross beta	0.77 ± 0.13	0.70 ± 0.13	0.95 ± 0.16	0.65 ± 0.19
Radium-226	na	0.004 ± 0.004	0.008 ± 0.004	0.005 ± 0.004

Table 9-36. Analytical results for Site 300 Building 829 area deep monitoring wells, 2000 (continued)

Constituents of concern	Sampling dates for W-829-15			
	2/28	5/11	8/24	12/5
Inorganic ($\mu\text{g/L}$)				
pH (pH units)	9.6	9.0	8.0	7.5
Conductivity ($\mu\text{S}/\text{cm}$)	1200	1240	1190	1320
Antimony	<5	<5	<5	<8
Arsenic	10	13	14	12
Barium	<25	<25	40	<50
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	4	5.5
Cobalt	<25	<25	<25	<200
Copper	<10	<10	<10	<50
Iron	<50	<50	<50	<50
Lead	<2	<2	<2	<2
Manganese	<10	<10	<10	<50
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<200
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<2	<2
Silver	<2	<0.5	<0.5	<5
Vanadium	<25	25	25	50
Zinc	<20	20	20	50
Chloride (mg/L)	92	87	84	82
Fluoride (mg/L)	0.24	0.23	0.23	0.29
Nitrate (as NO_3) (mg/L)	<0.4	1.7	1.3	1.3
Sodium (mg/L)	210	220	220	250
Sulfate (mg/L)	185	188	167	162
Organic ($\mu\text{g/L}$)				
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)	<1	<1	<1	<1
Benzene	0.58	<0.5	<0.5	<0.5
Carbon disulfide	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	<0.5	<0.5	<0.5
Freon 113	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5

**Table 9-36. Analytical results for Site 300 Building 829 area deep monitoring wells, 2000 (continued)**

Constituents of concern	Sampling dates for W-829-15			
	2/28	5/11	8/24	12/5
Organic (µg/L) (continued)				
Toluene	<0.5	<0.5	<0.5	<0.5
Total xylene isomers	<1	<1	<1	<1
Trichloroethene	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5
BHC, gamma isomer (Lindane)	na	<2	<2	<2
Bis(2-ethylhexyl)phthalate	na	<5	<5	<5
Endrin	na	<2	<2	<2
Phenol	na	<2	<2	<2
Total organic halides (TOX)	na	<20	77	na
Total organic carbon (TOC) (mg/L)	na	1.3	1.6	1.5
Total coliform (MPN/100 mL)	<2	<2	<2	<2
Explosives (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
TNT	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	-0.01 ± 0.04	-0.03 ± 0.04	-0.06 ± 0.04	-0.10 ± 0.11
Gross beta	1.88 ± 0.29	1.77 ± 0.28	2.08 ± 0.32	2.64 ± 0.44
Radium-226	na	0.004 ± 0.004	0.006 ± 0.004	0.004 ± 0.003

Table 9-36. Analytical results for Site 300 Building 829 area deep monitoring wells, 2000 (continued)

Constituents of concern	Sampling dates for W-829-22			
	2/28	5/11	8/24	12/5
Inorganic ($\mu\text{g/L}$)				
pH (pH units)	8.27	7.86	7.55	7.45
Conductivity ($\mu\text{S}/\text{cm}$)	1000	959	975	980
Antimony	<5	<5	<5	<8
Arsenic	<2	<2	<2	<2
Barium	<25	<25	<25	<50
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	1
Cobalt	<25	<25	<25	<200
Copper	<10	<10	<10	<50
Iron	<50	<50	<50	<250
Lead	<2	<2	<2	<2
Manganese	<10	<10	<100	<50
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<200
Nickel	<5	<5	<5	<5
Selenium	<2	<2	<2	<2
Silver	<2	<0.5	<0.5	<5
Vanadium	<25	<25	<25	<50
Zinc	<20	<20	<20	<50
Chloride (mg/L)	91	90	91	92
Fluoride (mg/L)	0.37	0.34	0.37	0.46
Nitrate (as NO_3) (mg/L)	<0.4	<0.4	<0.4	<0.4
Sodium (mg/L)	200	210	200	220
Sulfate (mg/L)	121	120	120	120
Organic ($\mu\text{g/L}$)				
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)	<1	<1	<1	<1
Benzene	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	<0.5	<0.5	<0.5
Freon 113	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene	<0.5	<0.5	<0.5	<0.5

**Table 9-36. Analytical results for Site 300 Building 829 area deep monitoring wells, 2000 (concluded)**

Constituents of concern	Sampling dates for W-829-22			
	2/28	5/11	8/24	12/5
Organic (µg/L) (continued)				
Toluene	<0.5	<0.5	<0.5	<0.5
Total xylene isomers	2.6	<1	<1	<1
Trichloroethene	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5
BHC, gamma isomer (Lindane)	na	<2	<2	<2
Bis(2-ethylhexyl)phthalate	na	<5	<5	<5
Endrin	na	<2	<2	<2
Phenol	na	<2	<2	<2
Total organic halides (TOX)	na	<20	81	<20
Total organic carbon (TOC) (mg/L)	na	2.0	<1	<1
Total coliform (MPN/100 mL)	<2	<2	<2	<2
Explosives (µg/L)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
TNT	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.01 ± 0.03	-0.003 ± 0.04	-0.03 ± 0.04	-0.01 ± 0.06
Gross beta	0.22 ± 0.06	0.24 ± 0.06	0.25 ± 0.06	0.28 ± 0.09
Radium-226	na	0.003 ± 0.003	0.001 ± 0.003	0.001 ± 0.003

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (sampling error)

Table 9-37. Analytical results for Site 300 Building 829 area shallow monitoring wells, 2000

Constituents of concern	Well							
	W-829-06				W-829-08			
	1/20	5/16	8/23	12/5	1/20	5/16	8/23	12/5
Organic (µg/L)								
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethene (total)	2.5	2.2	2.6	<7	<1	<1	<1	<1
Benzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	<5	<5	<5	<5	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Freon 113	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylene isomers	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	270	300	330	270	29	34	82	37
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Explosive (µg/L)								
HMX	<5	<5	<5	<5	<5	<5	<5	<5
RDX	<5	<5	<5	<5	<5	<5	<5	<5
TNT	<5	<5	<5	<5	<5	<5	<5	<5

Table 9-38. Site 300 potable standby supply well 18

Constituents of concern	Sampling dates			
	1/12/00	4/12/00	7/12/00	10/18/00
Organic (µg/L)				
EPA Method 502.2	nd (exc) ^(a)	nd (exc)	nd ^(b)	nd (exc)
Trichloroethene (TCE)	0.4	0.4	<0.2	0.5
Radioactive (Bq/L)				
Gross alpha	-0.022 ± 0.027	0.019 ± 0.044	-0.009 ± 0.028	-0.040 ± 0.048
Gross beta	0.11 ± 0.037	0.16 ± 0.041	0.19 ± 0.041	0.15 ± 0.056
Tritium	-0.4 ± 2.4	0.3 ± 2.1	0.1 ± 1.0	-0.2 ± 2.3

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd (exc) = None detected above reporting limits, except for constituents listed below the method.

b nd = None detected above reporting limits

**Table 9-39. Site 300 potable supply well 20**

Constituents of concern	Sampling dates			
	1/24/00	4/28/00	9/11/00	10/31/00
Inorganic ($\mu\text{g/L}$)				
Antimony	<5	<8	<5	<5
Arsenic	<2	<2	<2	<2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<2	9	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	<1	<2	<1	<1
Potassium (mg/L)	9	8	8	9
Selenium	<2	<2	<2	<4
Silver	<0.5	<2	<0.5	<2
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	25
Organic ($\mu\text{g/L}$)				
EPA Method 502.2	nd ^(a)	nd	nd	nd
Explosives ($\mu\text{g/L}$)				
HMX	<5	<5	<5	<5
RDX	<5	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	-0.012 ± 0.031	0.001 ± 0.025	-0.023 ± 0.04	-0.066 ± 0.056
Gross beta	0.27 ± 0.056	0.24 ± 0.048	0.19 ± 0.044	0.26 ± 0.081
Tritium	-0.2 ± 1.4	-1.2 ± 1.2	-2.8 ± 1.4	-2.4 ± 2.4

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd = None detected above reporting limits

Table 9-40. Site 300 off-site well CARNRW1

Constituents of concern	Sampling dates			
	1/20/00	4/28/00	7/25/00	10/31/00
Inorganic ($\mu\text{g/L}$)				
Perchlorate	na ^(a)	<4	na	na
Organic ($\mu\text{g/L}$)				
EPA Method 601 (volatile)	nd ^(b)	nd	nd	nd
Radioactive (Bq/L)				
Tritium	0.9 ± 2.0	-2.3 ± 2.0	-1.2 ± 2.2	0.7 ± 2.4

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

**Table 9-41. Site 300 off-site well CDF1**

Constituents of concern	Sampling dates			
	1/20/00	4/28/00	7/25/00	10/31/00
Inorganic ($\mu\text{g/L}$)				
pH (units)	7.1	7.1	7.7	7.0
Conductivity ($\mu\text{S/cm}$)	1300	1100	1240	1440
Temperature ($^{\circ}\text{C}$)	16.0	17.5	23.0	16.1
Antimony	<5	<8	<5	<5
Arsenic	6	3	6	3
Barium	<25	<25	<25	30
Beryllium	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	10
Lead	<4	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	1.0	2.5	1.5	1.0
Potassium (mg/L)	10	9	9	10
Selenium	<2	<2	<2	<4
Silver	<1	<2	<2	<2
Thallium	<1	<1	<2	<1
Vanadium	<25	<25	25	<25
Zinc	99	45	<20	62
Organic ($\mu\text{g/L}$)				
EPA Method 502.2	nd ^(a)	nd	nd	nd
EPA Method 625	na ^(b)	na	nd	na
Explosives ($\mu\text{g/L}$)				
HMX	na	<5	<5	<5
RDX	na	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	-0.003 ± 0.033	0.037 ± 0.033	0.031 ± 0.036	-0.02 ± 0.074
Gross beta	0.32 ± 0.067	0.29 ± 0.063	0.23 ± 0.093	0.29 ± 0.081
Tritium	-0.4 ± 1.3	0.3 ± 1.3	-0.3 ± 2.1	-1.3 ± 2.4
Uranium (total)	na	na	0.032 ± 0.005	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd = None detected above reporting limits

b na = Not analyzed (analysis not required)

Table 9-42. Site 300 off-site surveillance well CON1

Constituents of concern	Sampling dates			
	1/20/00	4/28/00	7/25/00	10/31/00
Inorganic ($\mu\text{g/L}$)				
pH (units)	7.6	7.4	7.9	7.2
Conductivity ($\mu\text{S}/\text{cm}$)	2300	na	2320	2390
Temperature ($^{\circ}\text{C}$)	20.5	20.9	22.8	21.0
Antimony	<5	<8	<5	<5
Arsenic	<2	<2	3	<2
Barium	<25	<25	<25	30
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	<10	<10	<10
Lead	<4	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<30	<25
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	<2	<1	<1	<1
Potassium (mg/L)	10	10	9	11
Selenium	<2	<2	<2	<4
Silver	<0.5	<2	<0.5	<2
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Organic ($\mu\text{g/L}$)				
EPA Method 502.2	nd ^(a)	nd	nd	nd
EPA Method 625	na ^(b)	na	nd	na
Explosives ($\mu\text{g/L}$)				
HMX	na	<5	<5	<5
RDX	na	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	-0.0003 ± 0.052	-0.07 ± 0.10	-0.003 ± 0.028	-0.011 ± 0.063
Gross beta	0.31 ± 0.067	0.47 ± 0.11	0.29 ± 0.10	0.28 ± 0.074
Tritium	-1.1 ± 1.3	-1.0 ± 1.2	-0.18 ± 2.1	-1.2 ± 2.4
Uranium (total)	na	na	0.004 ± 0.002	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd = None detected above reporting limits

b na = Not analyzed (analysis not required)

**Table 9-43. Site 300 off-site surveillance well GALLO1**

Constituents of concern	Sampling dates			
	1/25/00	4/28/00	7/25/00	10/31/00
Inorganic ($\mu\text{g/L}$)				
Antimony	<5	<8	<5	<5
Arsenic	6	<2	4	2
Barium	<25	<25	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<10	10	<10	<10
Lead	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	52	50	52	50
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	<1	1.1	<1	<1
Potassium (mg/L)	4.2	4.1	3.6	4.0
Selenium	<2	<2	<2	<4
Silver	<0.5	<2	<0.5	<2
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Organic ($\mu\text{g/L}$)				
EPA Method 502.2	nd (exc) ^(a)	nd (exc)	nd (exc)	nd (exc)
Trichloroethene (TCE)	0.2	0.5	0.6	0.6
EPA Method 625	na ^(b)	na	nd	na
Explosives ($\mu\text{g/L}$)				
HMX	na	<5	<5	<5
RDX	na	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	0.001 ± 0.041	-0.015 ± 0.032	0.007 ± 0.041	-0.021 ± 0.056
Gross beta	0.11 ± 0.036	0.10 ± 0.044	0.15 ± 0.074	0.05 ± 0.081
Tritium	-0.6 ± 1.4	0.4 ± 1.3	3.7 ± 2.3	-2.5 ± 2.4
Uranium (total)	na	na	0.001 ± 0.001	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd (exc) = None detected above reporting limits except for constituents listed below method

b na = Not analyzed (analysis not required)

Table 9-44. Site 300 off-site surveillance well CARNRW2

Constituents of concern	Sampling dates			
	1/20/00	4/28/00	7/25/00	10/31/00
Inorganic ($\mu\text{g/L}$)				
Antimony	<5	<8	<5	<5
Arsenic	3	<2	3	<2
Barium	<25	<5	<25	<25
Beryllium	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1
Cobalt	<25	<25	<25	<25
Copper	<1	<10	<10	<10
Lead	<4	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	30	30
Nickel	<5	<5	<5	<5
Nitrate (mg/L)	<1	<1	<1	<1
Potassium (mg/L)	9	9	8	9
Selenium	<2	<2	<2	<4
Silver	<0.5	<2	<0.5	<2
Thallium	<1	<1	<1	<1
Vanadium	<25	<25	<25	<25
Zinc	<20	<20	<20	<20
Organic ($\mu\text{g/L}$)				
EPA Method 502.2	nd ^(a)	nd	nd	nd
EPA Method 625	na ^(b)	na	nd	na
Explosives ($\mu\text{g/L}$)				
HMX	na	<5	<5	<5
RDX	na	<5	<5	<5
Radioactive (Bq/L)				
Gross alpha	-0.0002 ± 0.034	-0.021 ± 0.037	-0.038 ± 0.044	-0.002 ± 0.093
Gross beta	0.29 ± 0.063	0.21 ± 0.056	0.28 ± 0.081	0.30 ± 0.089
Tritium	0.3 ± 1.4	0.7 ± 1.3	-0.4 ± 2.1	-0.7 ± 2.4
Uranium (total)	na	na	0.001 ± 0.001	na

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd = None detected above reporting limits

b na = Not analyzed (analysis not required)

**Table 9-45. Site 300 off-site surveillance well CON2**

Constituents of concern	Sampling dates			
	2/24/00	4/26/00	7/18/00	10/31/00
Inorganic ($\mu\text{g}/\text{L}$)				
pH (units)	7.26	na ^(a)	na	7.06
Conductivity ($\mu\text{S}/\text{cm}$)	1200	na	na	1750
Temperature ($^{\circ}\text{C}$)	16.5	na	na	18.6
Organic ($\mu\text{g}/\text{L}$)				
EPA Method 601 (volatile)	nd ^(b)	nd	nd	nd

a na = Not analyzed (analysis not required)

b nd = None detected above reporting limits

Table 9-46. Annually monitored off-site surveillance wells, 2000

Constituents	Well					
	MUL1	MUL2	STONEHAM1	VIE1	VIE2	W-35A-04
	Sampling dates					
	9/6	9/6	9/7	9/6	9/7	9/26
Inorganic (µg/L)						
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	2	<2	<2	14	<2	<2
Barium	30	<25	40	50	40	75
Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	<1	<1	<1	<1	<1	1
Cobalt	<25	<25	<25	<25	<25	<25
Copper	20	40	88	20	20	30
Lead	<2	<2	<2	<2	<2	<2
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	<25	<25	<25	<25	<25	<25
Nickel	<5	<5	<5	<5	<5	7
Selenium	<2	<2	<2	<2	<2	<4
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<1	<1	<1	<1	<1	<1
Vanadium	<25	<25	<25	30	<25	<25
Zinc	150	<20	83	<20	37	<20
Potassium (mg/L)	5.8	9.7	8.1	7.7	2.5	6.8
Nitrate (as NO ₃) (mg/L)	8.84	13.4	4.1	32.2	36.3	9.2
Organic (µg/L)						
EPA Method 502.2	nd ^(a)	nd	nd	nd	nd	nd
EPA Method 608	nd	nd	nd	nd	nd	nd
EPA Method 615	na ^(b)	na	nd	na	na	nd
EPA Method 625	nd	nd	nd	nd	nd	nd
Explosive (µg/L)						
HMX	<5	<5	<5	<5	<5	<5
RDX	<5	<5	<5	<5	<5	<5
Radioactive (Bq/L)						
Gross alpha	0.14 ± 0.05	-0.06 ± 0.07	0.34 ± 0.14	0.09 ± 0.05	0.13 ± 0.08	0.1 ± 0.1
Gross beta	0.2 ± 0.04	0.32 ± 0.07	0.42 ± 0.11	0.26 ± 0.05	0.08 ± 0.07	0.24 ± 0.09
Tritium	-1.2 ± 1.5	0.1 ± 1.6	0.7 ± 1.6	-0.8 ± 1.5	1.2 ± 1.5	1.5 ± 1.7
Uranium (total)	0.17 ± 0.017	0.10 ± 0.012	0.36 ± 0.03	0.04 ± 0.005	0.17 ± 0.016	0.18 ± 0.016

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. A negative number means this value is less than the background count. See main volume, Chapter 14.

a nd = None detected above reporting limits

b na = Not analyzed (analysis not required)



SOIL AND SEDIMENT MONITORING

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Surface Soil Methods

Prior to 1988, surface soil samples were collected at sites selected at random from Livermore Valley locations. These sites had been previously sampled for a 1971–1972 study, conducted to determine background concentrations of radionuclides in area soils. In 1988, Livermore Valley surface soil sampling locations were chosen to coincide with air sampling locations, to cover areas with contaminants from past incidents, or to sample other areas of special concern (see **Figure 10-1**, in the main volume). In 1991, five additional soil sampling locations associated with air sampling locations were established. The 2000 Livermore Valley surface soil samples were collected from generally the same locations as those in 1991 to 1999. The 2000 Site 300 soil samples were collected from the same 14 locations as those sampled between 1990 and 1998. The PRIM location became inaccessible and was removed from the sampling program in 2000 because the site owner discontinued operations. Analysis for plutonium in Site 300 soils was discontinued in 1997 because plutonium has not been used at the site, and sample results have continuously been at background levels since sampling began in 1972. The use of established sampling locations is preferred, when possible, from year to year because it allows us to determine more meaningful trends in data.

Sampling locations at areas with known or suspected contaminants were monitored to delimit

the extent of the contaminants and to track the contaminants from year to year. For example, six surface soil sampling locations are used to monitor soils near the Livermore Water Reclamation Plant (LWRP). These soils contain slightly elevated plutonium levels due to the resuspension of sludge that had been contaminated from a significant accidental release in 1967, as well as other releases to the sewer. Surface soil sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1999). Samples are collected from undisturbed areas near the permanent sampling location marker. These areas generally are level, free of rocks, and unsheltered by trees or buildings. The sampling technicians choose two 1-m squares from which to collect the sample and record how far away and in what direction from the permanent marker the sample is collected. Each sample is a composite consisting of 10 subsamples that are collected with an 8.25-cm diameter stainless steel core sampler at the corners and the center of each square. All subsamples are collected from the top 5 cm of soil because surface deposition from the air is the primary pathway for potential contamination.

Quality assurance (QA) duplicate samples are submitted with each batch of soil samples. At locations chosen for duplicate sampling, two identical samples are obtained by collecting adjacent cores from the corners and center of the sampling squares. Separate composites of 10 cores



each are made, and the duplicate samples are identified with unique sample identifier codes.

Surface soil samples are dried, ground, sieved, and homogenized. Samples are analyzed by LLNL's Chemistry and Materials Science Environmental Services (CES) laboratory. The plutonium content of a 100-g sample aliquot is determined by alpha spectroscopy (Hall and Edwards 1994c). Other sample aliquots (300-g) are analyzed for more than 150 radionuclides by gamma spectroscopy, using a high-purity germanium (HPGe) detector (Hall and Edwards 1994a, b, and c). Only those nuclides measured above detection limits or of particular interest are reported. The 10-g subsamples of samples from Site 300 are sent to a contract analytical laboratory and are analyzed by graphite-furnace atomic absorption spectroscopy for beryllium. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Surface Sediment Methods

Surface samples of a sediment are collected from arroyos and storm water drainages at and around the Livermore site after the cessation of spring runoff. For 2000, samples were analyzed for radionuclides.

Sediment was sampled from seven Livermore site drainages. Location ALPO was covered in water throughout the sampling period and was not sampled (see **Figure 10-3**, in the main volume). The sediment sampling locations coincide with storm water runoff sampling locations so that the sampling results from these two media can be compared.

All surface sediment locations are marked by a permanent location marker, which serves as a reference point for each sampling location. Ten

subsamples, 5-cm deep, are collected at 1-m intervals along a transect of the arroyo or drainage channel. At one of the subsample locations, a 15-cm deep sample is acquired for tritium analysis. The sample collection technicians record how far away and in what direction from the permanent marker the samples are actually collected. As with soil samples, QA samples are submitted with each batch of sediment samples.

Samples are analyzed by LLNL's CES laboratory. For samples collected for tritium analyses, CES uses freeze-drying techniques to recover water from the samples and determines the tritium content of the water by liquid-scintillation counting. The plutonium content of a sample aliquot is determined by alpha spectroscopy. Other sample aliquots are analyzed for radionuclides using gamma spectroscopy as described above for surface soil samples. The radioanalytical methods employed by the CES laboratory enable detection of concentrations at levels far more sensitive than regulatory limits. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Vadose Zone Soil Methods

Vadose zone soil samples are collected at the same locations as the surface sediments. One of the 10 surface subsample locations is selected for collection of the deeper vadose zone samples. A hand auger is used to collect a 30- to 45-cm deep sample, which is submitted for analysis for total metals by EPA Methods 200.7, 245.2, 7471A and 6010B. Soluble extraction and metals analyses is carried out by California's Waste Extraction Test, followed by the same analyses as used for total metals on that extract. Through the use of an electric drive, a sample is collected at 45–65 cm deep for analysis of polychlorinated biphenyls by

EPA Method 8082 and for soluble extraction of volatile organic compounds by EPA's Toxicity Characteristic Leaching Procedure (EPA Method 1311), followed by EPA Method 8260 analysis. Chain-of-custody procedures are followed throughout the sampling, delivery, and analytical processes.

Data

Table 10-1 presents the analytical data for radionuclides for surface soil and sediment samples collected in 2000 in the Livermore Valley and Livermore site. Table 10-2 presents the data, which include radionuclides and beryllium, for samples collected at Site 300. The data generally reflect historic data values for these analytes at these locations. A detailed discussion of these results is provided in the main volume of this report. Tables 10-3 and 10-4 list background levels for total and soluble metals in soils and sediments and de minimis concentrations for organics. Table 10-5 presents analytical values for soluble volatile organic compounds in Livermore site sediments. Tables 10-6 and 10-7 give results for total and dissolved metals, respectively.

**Table 10-1. Radionuclides in soils and sediments in the Livermore Valley, 2000**

Location identifier	Plutonium-238 ($\mu\text{Bq}/\text{dry g}$)	Plutonium-239+240 ($\mu\text{Bq}/\text{dry g}$)	Americium-241 ($\text{mBq}/\text{dry g}$)	Cesium-137 ($\text{mBq}/\text{dry g}$)
Livermore Valley soils				
L-AMON-SO	1.49 ± 1.12	43.7 ± 5.37	—(d)	1.35 ± 0.216
L-CHUR-SO	2.70 ± 1.69	104 ± 9.47	—(d)	2.93 ± 0.194
L-COW-SO	3.37 ± 1.84	29.4 ± 4.29	—(d)	0.596 ± 0.131
L-FCC-SO	1.86 ± 1.23	61.1 ± 6.99	—(d)	2.03 ± 0.288
L-HOSP-SO	1.17 ± 0.936	47.7 ± 5.70	—(d)	1.38 ± 0.215
L-MESQ-SO	1.55 ± 1.01	35.8 ± 4.55	—(d)	0.833 ± 0.155
L-MET-SO	1.49 ± 1.32	51.1 ± 5.85	—(d)	1.75 ± 0.347
L-NEP-SO	3.85 ± 1.90	69.2 ± 6.66	—(d)	2.22 ± 0.213
L-PATT-SO	0.614 ± 0.836	26.4 ± 4.22	—(d)	0.718 ± 0.150
L-SALV-SO	5.14 ± 2.17	67.7 ± 6.81	—(d)	1.26 ± 0.204
L-TANK-SO	5.33 ± 2.29	118 ± 10.8	—(d)	3.44 ± 0.275
L-VIS-SO	19.5 ± 3.49	352 ± 19.5	—(d)	1.39 ± 0.276
L-ZON7-SO	10.5 ± 3.09	231 ± 15.8	—(d)	7.10 ± 0.385
Median	2.70	61.1	—(f)	1.39
Interquartile range	3.65	60.3	—(f)	0.96
Maximum	19.5	352	—(f)	7.1
LWRP soils				
L-WRP1-SO	377 ± 20.8	6440 ± 251	3.17 ± 0.692	4.07 ± 0.220
L-WRP2-SO	211 ± 14.3	4110 ± 162	1.81 ± 0.540	2.62 ± 0.199
L-WRP3-SO	62.9 ± 7.40	1130 ± 53.7	<0.83	0.307 ± 0.162
L-WRP4-SO	20.6 ± 4.03	385 ± 22.3	<0.69	0.381 ± 0.182
L-WRP5-SO	194 ± 13.8	3680 ± 154	<0.42	1.47 ± 0.261
L-WRP6-SO	23.9 ± 4.11	470 ± 25.1	<1.17	0.618 ± 0.249
Median	128	2410	<1.00	1.04
Interquartile range	173	3370	—(h)	1.89
Maximum	377	6440	3.17	4.07
Livermore site sediments				
L-ALPE-SD	0.918 ± 1.2	25.7 ± 4.07	—(d)	0.389 ± 0.157
L-ASS2-SD	0.440 ± 0.792	5.00 ± 1.75	—(d)	0.219 ± 0.159
L-ASW-SD	0.733 ± 0.984	8.47 ± 2.46	—(d)	0.133 ± 0.120
L-DRB1-SD	10.9 ± 2.69	98.1 ± 8.55	—(d)	0.148 ± 0.104
L-DRB2-SD	8.18 ± 2.41	77.0 ± 7.70	—(d)	<0.0463
L-DRB3-SD	42.2 ± 5.29	463 ± 24.0	—(d)	0.433 ± 0.105
L-DRB4-SD	13.1 ± 2.96	125 ± 9.81	—(d)	<0.0411
L-ESB-SD	174 ± 12.1	1740 ± 72.2	—(d)	0.681 ± 0.158
L-GRNE-SD	4.88 ± 1.85	80.7 ± 7.33	—(d)	1.11 ± 0.297
L-WPDC-SD	-0.851 ± 0.777	6.40 ± 2.26	—(d)	<0.078
Median	6.53	78.9	—(f)	0.184
Interquartile range	11.8	105	—(f)	0.330
Maximum	174	1740	—(f)	1.11

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

- a Thorium-232 activities in $\text{Bq}/\text{dry g}$ can be determined by dividing the weight in $\mu\text{g}/\text{dry g}$ by 247.3, and $\text{pCi}/\text{dry g}$ can be determined by dividing by 9.15.
- b Uranium-235 activities in $\text{Bq}/\text{dry g}$ can be determined by dividing the weight in $\mu\text{g}/\text{dry g}$ by 12.5, and in $\text{pCi}/\text{dry g}$ by dividing by 0.463.

Potassium-40 (Bq/dry g)	Tritium (Bq/L)	Thorium-232 ^(a) ($\mu\text{g}/\text{dry g}$)	Uranium-235 ^(b) ($\mu\text{g}/\text{dry g}$)	Uranium-238 ^(c) ($\mu\text{g}/\text{dry g}$)	Uranium- 235:238
Livermore Valley soils					
0.525 ± 0.0147	—(e)	8.68 ± 0.209	0.0272 ± 0.00935	2.87 ± 1.31	0.009 ± 0.005
0.470 ± 0.0179	—(e)	7.05 ± 0.211	0.0257 ± 0.0104	2.44 ± 1.46	0.011 ± 0.008
0.551 ± 0.0154	—(e)	6.73 ± 0.188	0.0198 ± 0.00829	1.94 ± 0.915	0.010 ± 0.006
0.377 ± 0.0105	—(e)	5.33 ± 0.138	0.0125 ± 0.00713	1.11 ± 0.888	0.011 ± 0.011
0.403 ± 0.0130	—(e)	4.90 ± 0.146	0.0170 ± 0.00727	1.49 ± 1.35	0.011 ± 0.011
0.496 ± 0.0099	—(e)	6.23 ± 0.124	0.0190 ± 0.00727	1.68 ± 0.891	0.011 ± 0.007
0.548 ± 0.0143	—(e)	6.74 ± 0.148	0.0209 ± 0.00912	1.78 ± 1.51	0.012 ± 0.011
0.474 ± 0.0180	—(e)	5.52 ± 0.155	0.0149 ± 0.00833	1.50 ± 1.07	0.010 ± 0.009
0.548 ± 0.0153	—(e)	7.25 ± 0.188	0.0251 ± 0.00907	2.32 ± 1.16	0.011 ± 0.007
0.396 ± 0.0111	—(e)	6.98 ± 0.140	0.0227 ± 0.00954	1.79 ± 1.08	0.013 ± 0.009
0.306 ± 0.0080	—(e)	5.86 ± 0.129	0.0169 ± 0.00940	1.37 ± 1.05	0.012 ± 0.012
0.374 ± 0.0104	—(e)	6.66 ± 0.160	0.0190 ± 0.00750	2.24 ± 1.79	0.008 ± 0.008
0.433 ± 0.0112	—(e)	6.84 ± 0.165	0.0188 ± 0.0117	0.86 ± 0.674	0.022 ± 0.022
0.470	na ^(g)	6.73	0.0190	1.78	na
0.129	na	1.12	0.0057	0.75	na
0.551	na	8.68	0.0272	2.87	na
LWRP soils					
0.396 ± 0.0143	—(e)	6.36 ± 0.166	0.0237 ± 0.00815	2.74 ± 1.08	0.009 ± 0.005
0.342 ± 0.0144	—(e)	6.30 ± 0.177	0.0193 ± 0.00824	2.25 ± 1.35	0.009 ± 0.006
0.349 ± 0.0112	—(e)	6.45 ± 0.193	0.0193 ± 0.0104	2.03 ± 1.22	0.010 ± 0.008
0.341 ± 0.0116	—(e)	6.29 ± 0.151	0.0148 ± 0.00685	1.85 ± 1.40	0.008 ± 0.007
0.366 ± 0.0095	—(e)	5.92 ± 0.142	0.0161 ± 0.00699	1.29 ± 0.743	0.012 ± 0.009
0.411 ± 0.0106	—(e)	6.33 ± 0.152	0.0204 ± 0.00792	1.73 ± 0.968	0.012 ± 0.008
0.358	na	6.32	0.0190	1.94	na
0.045	na	0.06	0.0030	0.44	na
0.411	na	6.45	0.0237	2.74	na
Livermore site sediments					
0.381 ± 0.00992	5.37 ± 2.26	4.47 ± 0.125	0.0154 ± 0.00815	1.57 ± 0.882	0.010 ± 0.008
0.470 ± 0.0141	0.892 ± 1.91	3.13 ± 0.125	0.0112 ± 0.00894	1.05 ± 0.796	0.011 ± 0.012
0.451 ± 0.00903	3.10 ± 2.15	3.01 ± 0.0961	0.00972 ± 0.00607	0.915 ± 0.659	0.011 ± 0.010
0.168 ± 0.00603	—(e)	2.81 ± 0.102	0.00778 ± 0.00579	0.710 ± 0.594	0.011 ± 0.012
0.154 ± 0.00551	—(e)	2.56 ± 0.0872	0.0100 ± 0.00477	0.971 ± 0.615	0.010 ± 0.008
0.233 ± 0.00699	—(e)	4.01 ± 0.120	0.0140 ± 0.00579	1.54 ± 0.523	0.009 ± 0.005
0.172 ± 0.00618	—(e)	2.53 ± 0.0961	0.00931 ± 0.00556	0.564 ± 0.451	0.017 ± 0.017
0.400 ± 0.00877	14.1 ± 1.86	3.18 ± 0.0827	0.00977 ± 0.00519	1.13 ± 0.603	0.009 ± 0.007
0.459 ± 0.0128	4.26 ± 2.56	6.81 ± 0.136	0.0175 ± 0.00857	1.48 ± 0.680	0.012 ± 0.008
0.459 ± 0.0137	4.81 ± 2.10	5.87 ± 0.141	0.0125 ± 0.00681	0.995 ± 0.647	0.013 ± 0.011
0.391	4.53	3.16	0.0106	1.02	na
0.270	1.84	1.50	0.0039	0.46	na
0.470	14.1	6.81	0.0175	1.57	na

c Uranium-238 activities in Bq/dry g can be determined by dividing the weight in $\mu\text{g}/\text{dry g}$ by 80.3, and in pCi/dry g by dividing by 2.97.

d Americium-241 was detected only in LWRP samples.

e Only sediment samples are analyzed for tritium. The samples collected within the Drainage Retention Basin were not analyzed for tritium because only particulate materials were of interest in these samples.

f Not calculated

g na = not applicable

h Interquartile range not calculated because of high incidence of reported values below detection limits.

**Table 10-2. Radionuclides and beryllium in soils at Site 300, 2000**

Location identifier	Cesium-137 (mBq/dry g)	Potassium-40 (Bq/dry g)	Thorium-232 ^(a) ($\mu\text{g}/\text{dry g}$)	Uranium-235 ^(b) ($\mu\text{g}/\text{dry g}$)	Uranium-238 ^(c) ($\mu\text{g}/\text{dry g}$)	Uranium 235/238	Beryllium (mg/kg)
3-801E-SO	0.940 ± 0.218	0.351 ± 0.0098	7.37 ± 0.147	0.0225 ± 0.00400	1.46 ± 0.422	0.015 ± 0.005	0.29
3-801N-SO	<0.084	0.342 ± 0.0102	7.96 ± 0.191	0.0227 ± 0.00796	2.29 ± 1.11	0.010 ± 0.006	0.36
3-801W-SO	2.38 ± 0.309	0.488 ± 0.0176	8.81 ± 0.211	0.0486 ± 0.0105	9.71 ± 1.32	0.005 ± 0.001	0.4
3-812N-SO	0.714 ± 0.155	0.407 ± 0.0098	5.02 ± 0.141	0.0690 ± 0.00676	29.3 ± 6.09	0.002 ± 0.001	1.1
3-834W-SO	1.65 ± 0.234	0.414 ± 0.0133	9.42 ± 0.169	0.0255 ± 0.00857	1.90 ± 0.882	0.013 ± 0.008	0.6
3-851N-SO	1.47 ± 0.182	0.451 ± 0.0117	11.1 ± 0.221	0.0301 ± 0.00940	2.47 ± 1.19	0.012 ± 0.007	0.63
3-856N-SO	2.44 ± 0.249	0.359 ± 0.0086	8.41 ± 0.151	0.0228 ± 0.00704	1.89 ± 1.23	0.012 ± 0.009	0.47
3-858S-SO	2.79 ± 0.307	0.507 ± 0.0131	8.46 ± 0.169	0.0345 ± 0.0101	1.80 ± 1.26	0.019 ± 0.015	0.3
3-DSW-SO	0.836 ± 0.235	0.403 ± 0.0129	8.08 ± 0.194	0.0348 ± 0.0103	4.19 ± 2.53	0.008 ± 0.006	<0.25
3-EOBS-SO	1.41 ± 0.194	0.500 ± 0.0210	8.81 ± 0.229	0.0330 ± 0.0108	1.74 ± 0.947	0.019 ± 0.012	0.42
3-EVAP-SO	0.540 ± 0.150	0.389 ± 0.0116	7.80 ± 0.187	0.0325 ± 0.00472	3.15 ± 0.517	0.010 ± 0.002	<0.25
3-GOLF-SO	5.00 ± 0.488	0.496 ± 0.0129	7.60 ± 0.167	0.0288 ± 0.0146	1.09 ± 0.888	0.026 ± 0.025	<0.25
3-NPS-SO	3.96 ± 0.302	0.551 ± 0.0122	6.84 ± 0.150	0.0192 ± 0.00500	1.47 ± 0.318	0.013 ± 0.004	<0.25
3-WOBS -SO	1.56 ± 0.147	0.352 ± 0.0127	4.78 ± 0.153	0.0176 ± 0.0103	1.66 ± 1.45	0.011 ± 0.011	<0.25
Median	1.56	0.414	8.08	0.0301	1.90	—(d)	0.36
Interquartile range	1.60	0.107	1.21	0.0117	1.41	—(d)	—(e)
Maximum	5.00	0.551	11.1	0.0690	29.3	—(d)	1.1

Note: Radioactivities are reported as the measured concentration and either an uncertainty ($\pm 2\sigma$ counting error) or as being less than or equal to the detection limit. If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

- a Thorium-232 activities in Bq/dry g can be determined by dividing the weight in $\mu\text{g}/\text{dry g}$ by 247.3, and pCi/dry g can be determined by dividing by 9.15.
- b Uranium-235 activities in Bq/dry g can be determined by dividing the weight in $\mu\text{g}/\text{dry g}$ by 12.5, and pCi/dry g can be determined by dividing by 0.463.
- c Uranium-238 activities in Bq/dry g can be determined by dividing the weight in $\mu\text{g}/\text{dry g}$ by 80.3, and pCi/dry g can be determined by dividing by 2.97.
- d Not calculated
- e Interquartile range not calculated because of high incidence of reported values below detection limits.

Table 10-3. Background screening concentration values for metals in soils at the Livermore site

Metal	Background screening value Total (mg/kg)	Metal	Background screening value Soluble (mg/L)
Antimony	1.12	Antimony	Any detection
Arsenic	8.51	Arsenic	0.237
Barium	308	Barium	16.7
Beryllium	0.62	Beryllium	Any detection
Cadmium	1.59	Boron	To be determined
Chromium	72.4	Cadmium	Any detection
Chromium(VI)	Any detection	Chromium	0.727
Cobalt	14.6	Cobalt	0.985
Copper	62.5	Copper	2.6
Lead	43.7	Iron	To be determined
Mercury	0.14	Lead	0.987
Molybdenum	Any detection	Manganese	To be determined
Nickel	82.8	Mercury	0.0063
Selenium	Any detection	Molybdenum	Any detection
Silver	Any detection	Nickel	1.68
Thallium	Any detection	Selenium	Any detection
Vanadium	65.2	Silver	Any detection
Zinc	75.3	Thallium	Any detection
		Vanadium	1.22
		Zinc	4.52

Note: Background values were developed for all soils and sediments at the Livermore site but are used here as a basis for comparison for analytical results for vadose zone soils.


Table 10-4. De minimis concentration levels for organic and radioactive constituents of concern found in Livermore site soils and sediments

Constituents	Water quality objective	Reference	Attenuation factor	De minimis level
Organics (µg/L)				
1,2-Dichlorobenzene	600	CA Primary MCL ^(a)	100	3000
1,3-Dichlorobenzene	600	CA DHS Action Level	100	650
1-4-Dichlorobenzene	5	Cal Primary MCL	100	25
1,1-Dichloroethane	5	Cal Primary MCL	100	25
1-2-Dichloroethane	0.5	Cal Primary MCL	100	2.5
1,1-Dichloroethene	6	Cal Primary MCL	100	30
1,2-Dichloroethene	6	Cal Primary MCL	100	30
cis-1,2-Dichloroethene	6	Cal Primary MCL	100	30
trans-1,2-Dichloroethene	10	Cal Primary MCL	100	50
1,1,1-Trichloroethane	200	Cal Primary MCL	100	1000
1,1,2-Trichloroethane	5	Cal Primary MCL	100	25
Benzene	1	Cal Primary MCL	100	5
Carbon tetrachloride	0.5	Cal Primary MCL	100	2.5
Chlorobenzene	70	Cal Primary MCL	100	350
Chloroform	100	EPA Primary MCL	100	400
Diesel oil/kerosene	100	SNARL ^(b)	100	500
Ethyl benzene	700	Cal Primary MCL	100	3500
Freon 11 (trichlorofluoromethane)	150	Cal Primary MCL	100	750
Freon 12 (dichlorodifluoromethane)	1000	CA DHS Action Level	100	5000
Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane)	1200	Cal Primary MCL	100	6000
Gasoline	5	Other ^(c)	100	25
Methylene chloride	5	Cal Primary MCL	100	25
Methyl tertiary-butyl ether (MTBE)	13	Cal Primary MCL	100	65
Tetrachloroethene (PCE)	5	Cal Primary MCL	100	25
Toluene	150	Cal Primary MCL	100	750
Trichloroethene (TCE)	5	Cal Primary MCL	100	25
Xylene(s)	1750	Cal Primary MCL	100	8750
PCB (total)	0.5	Cal Primary MCL	100	2.5
Vinyl chloride	0.5	Cal Primary MCL	100	2.5

Table 10-4. De minimis concentration levels for organic and radioactive constituents of concern found in Livermore site soils and sediments (concluded)

Constituents	Water quality objective	Reference	Attenuation factor	De minimis level
Radioactivity (Bq/L)				
Gross alpha	0.56	Cal Primary MCL	100	5.6
Gross beta	1.9	Cal Primary MCL	100	19
Tritium	740	Cal Primary MCL	100	7400

Note: De minimis values were developed for all soils and sediments at the Livermore site but are used here as a basis for comparison for analytical results for vadose zone soils.

a MCL = Maximum contaminant level

b SNARL = Suggested No Adverse Response Level

c Other = Taste and odor threshold for gasoline

Table 10-5. Volatile organic compounds measured by EPA Method 1311, followed by Method 8260 in Livermore site vadose zone soil, 2000

Organic compounds ($\mu\text{g}/\text{L}$)	ASS2	ASW	ALPE ^(a)	GRNE	WPDC	ESB ^(a)
Benzene	<5	<5	<20	<5	<5	<20
Carbon tetrachloride	<2.5	<2.5	<20	<2.5	<2.5	<20
Chlorobenzene	<10	<10	<20	<10	<10	<20
Chloroform	10	10	<20	<10	<10	<20
1,4-Dichlorobenzene	<10	<10	<20	<10	<10	<20
1,2-Dichloroethane	<2.5	<2.5	<20	<2.5	<2.5	<20
1,1-Dichloroethene	<10	<10	<20	<10	<10	<20
2-Butanone	<10	<10	<20	<10	<10	<20
Trichloroethene	<10	<10	<20	<10	<10	<20
Vinyl chloride	<10	<10	<20	<10	<10	<20

a Detection limits at locations ALPE and ESB were elevated due to matrix interferences.

**Table 10-6. Total metals in Livermore site vadose zone soil, 2000**

Total metals (mg/kg)	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin
	Influent	Effluent	Influent		Effluent	
	ASS2	ASW	ALPE	GRNE	WPDC	ESB
Antimony	<1	<2	<1	<1	<1	<1
Arsenic	1.6	3.7	2.7	3.2	2.5	2.4
Barium	46	139	190	180	200	170
Beryllium	<0.5	<1	<0.5	<0.5	<0.5	<0.5
Cadmium	0.3	0.8	0.4	0.3	0.5	1.6
Chromium	18	40	23	12	30	28
Cobalt	<5	11	9	8	10	9
Copper	8	17	13	8	18	23
Lead	<10	<20	<10	<10	<10	20
Mercury	<0.05	<0.1	<0.05	<0.05	<0.05	0.09
Molybdenum	<5	<10	<5	<5	<5	<5
Nickel	20	50	30	20	40	40
Potassium	800	1700	1400	1000	1700	1400
Selenium	<2.5	<5	<2.5	<2.5	<2.5	<2.5
Silver	<2.5	<5	<2.5	<2.5	<2.5	<2.5
Thallium	<1	<2	<1	<1	<1	<1
Vanadium	13	29	30	21	29	24
Zinc	39	66	24	17	32	45

Table 10-7. Soluble metals in Livermore site vadose zone soil, 2000

Soluuable metals (mg/L)	Arroyo Seco		Arroyo Las Positas			Drainage Retention Basin
	Influent	Effluent	Influent		Effluent	
	ASS2	ASW	ALPE	GRNE	WPDC	
Antimony	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Arsenic	0.05	0.05	<0.05	0.08	<0.05	0.06
Barium	5.1	4.7	8.3	10	8.9	7.3
Beryllium	<0.04	<0.04	<0.04	<0.06	<0.04	<0.04
Boron	<0.5	<0.5	1.3	0.6	<0.5	0.7
Cadmium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	28	28	6	37	17	32
Lead	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Manganese	22	19	26	22	19	27
Mercury	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	<0.5	<0.5	0.7	<0.5	0.7	0.7
Potassium	40	40	20	20	<10	20
Selenium	0.05	<0.05	0.05	<0.05	<0.05	<0.05
Silver	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	<0.02	<0.02	0.02	<0.02	<0.02	<0.02
Vanadium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	1	0.7	<0.5	<0.5	<0.5	1.2

VEGETATION AND FOODSTUFF MONITORING

S. Ring Peterson

Introduction

This chapter discusses the sampling methods Lawrence Livermore National Laboratory uses to monitor vegetation and wine, including a description of how sampling locations are selected, what types and amounts of samples are collected, and the process for handling the samples. Tritium is the only radionuclide released to the environment from LLNL activities that can be measured, and therefore monitored, in vegetation and wine.

Vegetation Sampling Methods

The vegetation sampling locations chosen by Lawrence Livermore National Laboratory were areas with ample living vegetation during most of the year. Sampling locations were distant from buildings or other obstructions that could have caused unusual patterns of airflow or precipitation. Irrigated or shaded areas were also avoided. Practical considerations, such as access during inclement weather and personnel safety during vehicle operation or sample collection, also affected selection of sampling locations.

Sampling locations for 2000 were the same as in 1999 except that the location, PRIM, at Site 300, was replaced after the first quarter by COHO (Table 11-1). The routine vegetation sampling locations are designated with permanent location markers. Consistent use of the same general sampling locations allows LLNL to determine

more meaningful trends in data and to monitor areas of concern more closely. For example, every year at Site 300, LLNL examines vegetation from areas where tritium is known to be present in the subsurface soil.

Vegetation sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1999). In 2000, annual grasses and weeds were sampled quarterly. LLNL collected approximately 100 to 200 g of vegetation with relatively high water content for each analysis; a sample of equal size from the same location was also collected for archiving. Standard chain-of-custody procedures were followed.

Samples were delivered within three days of collection to LLNL's Chemistry and Materials Science Environmental Services laboratory and were kept frozen prior to processing. Water from the vegetation was collected using freeze-drying techniques (lyophilization), and the tritium concentration of the extracted water was determined by liquid-scintillation counting (Table 11-1).

Approximately 10% of the sites were sampled in duplicate to comply with quality assurance protocols. Duplicate samples were preserved, stored, processed, and analyzed with methods identical to those employed for all other samples.



Wine Sampling Methods

For sampling purposes, LLNL has divided California into nine wine-growing regions (including Livermore). Europe has been divided into 13 (Tate et al. 1999). In 2000, LLNL purchased 12 wines from the Livermore Valley, 1 wine from each of 6 California wine growing regions (excluding Livermore), and 1 wine from each of 4 European wine growing regions (see Table 11-2). An equal mix of red and white wines was selected from the Livermore Valley, other California wine-growing areas, and Europe. Any estate-bottled wine from a designated area was considered representative of that area. Selection of wines from a particular wine-growing region was based primarily on availability in local stores. Samples were purchased in 750-mL bottles. Approximately 10% of the total complement of wines was sampled in duplicate to comply with quality assurance protocols. Because of the importance of the wine-sampling network, LLNL either samples or archives as many of the available Livermore Valley wines as possible.

Wine sampling is conducted according to written, standardized procedures contained in the *Environmental Monitoring Plan* (Tate et al. 1999). The wine samples were submitted unopened to the laboratory for analysis to prevent potential airborne tritium contamination. Chain-of-custody procedures were followed when delivering the samples and throughout the analytical process. LLNL analyzed wines for tritium using ${}^3\text{He}$ mass spectrometry in the Isotope Sciences Division Noble Gas Mass Spectrometry Laboratory (Surano et al. 1991). Using this highly sensitive method, the minimum detectable tritium concentration is about 0.056 Bq/L (1.5 pCi/L), well below the measured concentrations in wine (Table 11-2). Conventional scintillation detection systems typically have detection limits between 3.7 and 19 Bq/L (100–500 pCi/L) depending on sample size and counting times. With great care, a scintillation detection system's sensitivity can reach about 1 Bq/L (27 pCi/L); however, this detection level is still not sensitive enough to detect small differences in wine samples.

**Table 11-1. Concentrations of tritium in plant water (Bq/L) collected quarterly from various sampling locations, 2000**

	First quarter	Second quarter	Third quarter	Fourth quarter	Median	Inter-quartile range	Dose (nSv/y) ^(a)	
	Median	Maximum						
Sampling locations within 1 km of the Livermore site perimeter								
AQUE	0.28 ± 1.4	4.1 ± 2.2	2.3 ± 1.2	1.6 ± 1.6	2.0	1.5	9.8	20
VIS	0.36 ± 1.4	8.9 ± 2.3	5.8 ± 1.4	6.5 ± 1.8	6.2	2.7	30	44
NPER	2.7 ± 1.6	12 ± 2.5	5.1 ± 1.4	7.3 ± 1.8	6.2	4.0	30	59
MET	0.43 ± 1.5	1.4 ± 2.0	1.8 ± 1.2	2.0 ± 1.6	1.6	0.69	7.8	9.8
MESQ	1.4 ± 1.5	4.7 ± 2.2	-0.56 ± 1.0	1.6 ± 1.6	1.5	1.5	7.4	23
GARD	2.4 ± 1.5	-0.32 ± 2.0	-0.66 ± 1.0	0.73 ± 1.5	0.21	1.6	1.0	12
PIN1	35 ± 2.8	48 ± 3.6	70 ± 3.6	240 ± 6.4	59	68	—(b)	—(b)
PIN2	4.4 ± 1.7	5.5 ± 2.2	9.5 ± 1.6	5.1 ± 1.8	5.3	1.6	—(b)	—(b)
Sampling locations 1–5 km from the Livermore site perimeter								
PATT	0.78 ± 1.5	1.7 ± 2.1	0.88 ± 1.1	0.44 ± 1.5	0.83	0.39	4.1	8.3
ZON7	3.0 ± 1.6	4.6 ± 2.2	8.3 ± 1.6	4.2 ± 1.7	4.4	1.6	22	41
I580	1.4 ± 1.5	2.2 ± 2.1	-0.028 ± 1.1	0.33 ± 1.5	0.87	1.4	4.3	11
TESW	-0.58 ± 1.4	2.3 ± 2.1	0.97 ± 1.2	-0.13 ± 1.5	0.42	1.5	2.1	11
Sampling locations more than 5 km from the Livermore site perimeter								
FCC	0.70 ± 1.4	0.99 ± 2.0	0.53 ± 1.1	-0.25 ± 1.5	0.62	0.44	3.0	4.9
CAL	-0.50 ± 1.4	1.8 ± 2.1	-0.70 ± 1.0	-0.47 ± 1.5	-0.49	0.65	—(c)	8.8
PARK	1.4 ± 1.5	1.9 ± 2.1	-0.47 ± 1.0	0.42 ± 1.5	0.91	1.3	4.5	9.3
Sampling locations at Site 300								
CARN	0.25 ± 1.4	-0.20 ± 2.0	0.92 ± 1.1	0.34 ± 1.5	0.30	0.35	1.5	4.5
GOLF	-0.10 ± 1.4	0.51 ± 2.0	-0.20 ± 1.0	1.0 ± 1.5	0.21	0.76	1.0	4.9
GEO	-0.52 ± 1.4	-0.49 ± 2.0	1.6 ± 1.2	0.16 ± 1.5	-0.17	1.0	—(c)	7.8
DSW	1.0 ± 1.5	5.6 ± 2.2	1300 ± 15	5.9 ± 1.8	5.8	320	28	6400
801E	-0.11 ± 1.4	0.63 ± 2.0	-0.54 ± 1.0	0.95 ± 1.5	0.26	0.93	1.3	4.7
EVAP	-0.18 ± 1.4	290 ± 7.7	90 ± 4.0	220 ± 6.1	160	170	780	1400
PRIM ^(d)	-1.3 ± 1.3	—(d)	—(d)	—(d)	NA	NA	—(c)	—(c)
COHO ^(d)	—(d)	0.79 ± 2	0.015 ± 1.1	1.8 ± 1.6	0.79	0.89	3.9	8.8

Note: Radioactivities are reported here as the measured concentration and an uncertainty ($\pm 2\sigma$ counting error). If the concentration is less than or equal to the uncertainty or the detection limit, the result is considered to be a nondetection. See the main volume, Chapter 14.

- a Ingestion dose is based on conservative assumptions that an adult's diet is exclusively vegetables with this tritium concentration, and that meat and milk are derived from livestock fed on grasses with the same concentration of tritium (see Appendix A). Note that doses are reported in nSv/y rather than the μ Sv/y of earlier years.
- b Doses were not calculated because pine trees are not ingested by human beings; an ingestion dose to the maximally exposed individual was calculated with CAP88-PC (see Chapter 13 in the main volume) using evapotranspiration from PIN1 as a diffuse source of tritium. The median dose was 0.0045 nSv/y, and the maximum dose 0.018 nSv/y.
- c Dose is not calculated when the concentration is negative.
- d The location PRIM was replaced by the location COHO after the first quarter sample.

**Table 11-2. Tritium in retail wine (Bq/L), 2000^(a)**

Sample	Area of production		
	Livermore Valley	California	Europe
1	1.05 ± 0.21	0.405 ± 0.19	0.818 ± 0.20
2	1.36 ± 0.23	0.410 ± 0.19	0.874 ± 0.20
3	1.38 ± 0.23	0.411 ± 0.19	1.43 ± 0.23
4	1.42 ± 0.23	0.436 ± 0.19	1.61 ± 0.25
5	1.48 ± 0.24	0.447 ± 0.19	
6	1.78 ± 0.26	0.584 ± 0.19	
7	1.81 ± 0.26		
8	1.82 ± 0.26		
9	1.86 ± 0.26		
10	2.15 ± 0.28		
11	2.30 ± 0.30		
12	2.62 ± 0.32		
Median	1.80	0.424	1.15
Interquartile range	0.523	0.0340	0.615
Mean	1.75	0.449	1.18
Standard deviation	0.447	0.0683	0.397
Dose (nSv/y)^(b)			
Median concentration	2.0	0.38	1.0
Mean concentration	1.6	0.40	1.0
Maximum concentration	2.4	0.53	1.4

Note: Radioactivities are reported here as the measured concentration and an uncertainty ($\pm 2\sigma$ counting error). If the concentration is less than or equal to the uncertainty, the result is considered to be a nondetection. See the main volume, Chapter 14, Quality Assurance.

a Wines from a variety of vintages were purchased and analyzed in 2000. The concentrations reported are those at the time the bottle was opened.

b This dose is calculated based on consumption of 52 L wine per year (see Appendix A).



ENVIRONMENTAL RADIATION MONITORING

Nicholas A. Bertoldo

Methods of Gamma Radiation Monitoring

The environmental gamma-radiation dose from terrestrial and cosmic sources is monitored at 14 locations on the laboratory site perimeter, twenty-three locations in the Livermore Valley, eight locations on the Site 300 perimeter, five sites in the vicinity of Site 300, and at two locations in the City of Tracy. Thermoluminescent dosimeters (TLDs) are deployed to the field on a quarterly basis following laboratory preparation. Each TLD is labeled with a Lawrence Livermore National Laboratory dosimeter identification number and placed into an aluminized mylar sample pouch for protection from moisture. Duplicate trip blanks, transit control, and calibration control TLDs are prepared in the same way as the environmental samples. Each TLD deployed in the field is placed such that the sample is located at approximately 1 m above ground to comply with *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (U.S. Department of Energy 1991). Upon their removal from the site locations at the end of each quarter, the environmentally exposed TLDs are taken to the LLNL Hazards Control dosimetry laboratory for processing. A chain-of-custody form accompanies the field deployment and the collection of the TLDs. Details of the TLD calculations and reporting of external gamma-

radiation dose are described in an Operations and Regulatory Affairs Division procedure.

LLNL uses the Panasonic Model UD-814AS1 TLD, which contains three thallium-activated calcium sulfate crystals (CaSO_4) and one lithium borate crystal ($\text{Li}_2\text{B}_4\text{O}_7$). The gamma-ray energy imparted to the TLD's crystal elements excite the electrons in the valence band to a higher energy state, creating a vacancy in the valence band known as a "hole." These electron holes are trapped in impurity sites within the crystal. When the TLDs are heated in the analytical laboratory, the thermal energy of the process raises the electron trap to the conduction band or the hole trap to the valence band, causing thermoluminescence. This light intensity is proportional to the original gamma-ray energy imparted to the TLD crystal elements (i.e., the TLD absorbed dose). This trapped energy is released in the form of light emission that is then measured by the photomultiplier tube output signal. After the TLD is measured, it is reheated and remeasured. A near-zero reading indicates that all the stored energy has been released. This process, called annealing, also verifies that the TLD is again ready for field deployment. When a TLD is found open on the ground, damaged, or lost, the associated annual dose reported is calculated from the average of the available mean quarterly dose values for that given location.

Gamma-radiation exposure is measured in roentgens (R), which is defined as the electronic charge required to ionize a given volume of air (2.54×10^{-4} C/kg air). The equivalent absorbed dose is 8.7×10^{-3} Gy (0.87 rad) in air. The tissue equivalent absorbed dose is 9.6×10^{-3} Gy (0.96 rad). The measured exposure is converted to dose equivalent by calibrating the dosimeters against sources that deliver a known absorbed dose and then applying the gamma-radiation quality factor of 1. The resultant dose-equivalent is reported for environmental dose in submultiple factors of 1×10^{-3} sieverts or millisieverts (mSv) and compared to Department of Energy (DOE) Order 5400.5 radiation protection standards. Site boundary doses are compared to environmental background measurements to assess the contribution or impact, if any, from LLNL operations.

To ensure accuracy in TLD measurements, some TLDs are irradiated each quarter to specific exposures for calibration purposes, and others are irradiated to specific exposures to serve as quality-control accuracy checks. Duplicate TLDs are located in the field at several locations each quarter to assess TLD measurement precision. When the field deployment time is either less than or exceeds 90 days, the data is normalized to a standard, 90-day quarter or 360 days per year for the purpose of comparison. LLNL participates in the National Intercomparison Laboratory Study for external gamma radiation measurements, and LLNL processing complies with the DOE Environmental Measurement Laboratory standards.

Tables

Data tables for the 2000 gamma-radiation monitoring network are presented below. Table 12-1 presents the Livermore site perimeter data, Table 12-2 presents the Livermore Valley data, Table 12-3 presents the Site 300 perimeter data, and Table 12-4 presents Tracy and other Site 300 off-site data. Summary data are discussed in detail in Chapter 12 of the main volume of this report.

Table 12-1. Calculated dose from TLD environmental radiation measurements, Livermore site perimeter, 2000

Location ^(a)	Quarterly dose (mSv) ^(b)				Annual Dose ^(c) (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
L-001-TD	0.154 ± 0.003	0.149 ± 0.017	0.149 ± 0.005	0.155 ± 0.015	0.607 ± 0.006
L-004-TD	0.147 ± 0.010	0.155 ± 0.005	0.142 ± 0.011	0.151 ± 0.010	0.595 ± 0.011
L-005-TD	0.156 ± 0.016	0.151 ± 0.003	0.152 ± 0.005	0.158 ± 0.015	0.617 ± 0.006
L-006-TD	0.163 ± 0.008	0.150 ± 0.002	0.167 ± 0.006	0.169 ± 0.006	0.649 ± 0.017
L-011-TD	0.124 ± 0.009	0.114 ± 0.002	0.114 ± 0.000	0.127 ± 0.004	0.479 ± 0.013
L-014-TD	0.170 ± 0.031	0.140 ± 0.010	0.126 ± 0.006	0.145 ± 0.003	0.581 ± 0.036
L-016-TD	0.144 ± 0.013	0.135 ± 0.006	0.140 ± 0.008	0.146 ± 0.005	0.565 ± 0.009
L-042-TD	0.140 ± 0.009	0.143 ± 0.006	0.145 ± 0.007	0.151 ± 0.013	0.579 ± 0.009
L-043-TD	0.136 ± 0.010	0.169 ± 0.014	0.132 ± 0.009	0.137 ± 0.016	0.574 ± 0.034
L-047-TD	0.134 ± 0.012	0.125 ± 0.008	0.128 ± 0.016	0.124 ± 0.001	0.511 ± 0.008
L-052-TD	0.142 ± 0.004	0.135 ± 0.007	0.145 ± 0.014	0.137 ± 0.005	0.559 ± 0.009
L-056-TD	0.139 ± 0.004	0.133 ± 0.002	0.146 ± 0.010	0.145 ± 0.007	0.563 ± 0.012
L-068-TD	0.149 ± 0.005	0.144 ± 0.004	0.144 ± 0.006	0.149 ± 0.013	0.586 ± 0.005
L-069-TD	0.140 ± 0.002	0.132 ± 0.007	0.143 ± 0.010	0.145 ± 0.016	0.560 ± 0.011
Mean^(d)	0.145 ± 0.006	0.141 ± 0.007	0.140 ± 0.006	0.145 ± 0.006	0.571 ± 0.002

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See main volume, **Figure 12-1**, for locations.

b Measurement uncertainty is reported as $\pm 2\sigma$ of the data.

c Uncertainty is reported as twice the propagated error of the quarterly means.

d Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

Table 12-2. Calculated dose from TLD environmental radiation measurements, Livermore valley, 2000.

Location ^(a)	Quarterly dose (mSv) ^(b)				Annual dose ^(c) (mSv)
	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec	
V-018-TD	0.114 ± 0.005	0.111 ± 0.006	0.115 ± 0.006	0.117 ± 0.003	0.457 ± 0.004
V-019-TD	0.139 ± 0.004	0.126 ± 0.002	0.122 ± 0.000	0.140 ± 0.008	0.527 ± 0.018
V-022-TD	0.155 ± 0.006	0.151 ± 0.007	0.161 ± 0.013	0.162 ± 0.009	0.629 ± 0.010
V-024-TD	0.151 ± 0.009	0.146 ± 0.009	0.153 ± 0.006	0.150 ± 0.004	0.600 ± 0.005
V-027-TD	0.126 ± 0.007	0.120 ± 0.005	0.130 ± 0.016	0.136 ± 0.007	0.512 ± 0.013
V-028-TD	0.166 ± 0.003	— ^(d)	0.130 ± 0.000	0.137 ± 0.011	0.433 ± 0.038
V-030-TD	0.142 ± 0.013	0.135 ± 0.004	0.138 ± 0.004	0.143 ± 0.010	0.558 ± 0.007
V-032-TD	0.139 ± 0.002	0.140 ± 0.001	0.133 ± 0.008	0.139 ± 0.003	0.551 ± 0.006
V-033-TD	0.146 ± 0.007	— ^(d)	0.145 ± 0.012	0.165 ± 0.017	0.456 ± 0.022
V-035-TD	— ^(d)	0.169 ± 0.003	0.150 ± 0.012	0.152 ± 0.005	0.471 ± 0.020
V-037-TD	0.156 ± 0.015	0.139 ± 0.008	0.147 ± 0.007	0.152 ± 0.015	0.594 ± 0.014
V-045-TD	0.172 ± 0.008	0.132 ± 0.001	0.133 ± 0.006	0.136 ± 0.001	0.573 ± 0.038
V-057-TD	0.159 ± 0.005	0.148 ± 0.004	0.159 ± 0.012	0.153 ± 0.012	0.619 ± 0.010
V-060-TD	0.150 ± 0.007	0.135 ± 0.006	0.143 ± 0.010	0.150 ± 0.003	0.578 ± 0.014
V-061-TD	0.140 ± 0.007	— ^(e)	— ^(e)	— ^(e)	— ^(f)
V-066-TD	0.147 ± 0.006	0.150 ± 0.006	0.149 ± 0.018	0.146 ± 0.004	0.592 ± 0.003
V-070-TD	0.139 ± 0.008	0.143 ± 0.006	0.133 ± 0.001	0.140 ± 0.001	0.555 ± 0.010
V-072-TD	0.171 ± 0.011	0.169 ± 0.014	0.174 ± 0.004	0.174 ± 0.006	0.688 ± 0.005
V-074-TD	0.136 ± 0.004	0.118 ± 0.002	— ^(d)	0.131 ± 0.010	0.385 ± 0.018
V-075-TD	0.115 ± 0.003	0.114 ± 0.004	0.108 ± 0.005	0.120 ± 0.010	0.457 ± 0.009
V-076-TD	0.122 ± 0.006	0.121 ± 0.004	0.120 ± 0.003	0.128 ± 0.010	0.491 ± 0.007
V-077-TD	0.141 ± 0.004	0.129 ± 0.003	0.137 ± 0.009	0.139 ± 0.006	0.546 ± 0.010
V-122-TD	— ^(g)	0.156 ± 0.003	0.179 ± 0.010	0.159 ± 0.016	0.494 ± 0.025
Mean^(h)	0.144 ± 0.007	0.137 ± 0.007	0.140 ± 0.007	0.144 ± 0.006	0.565 ± 0.003

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See main volume, **Figure 12-2**, for locations.

b Measurement uncertainty is reported as $\pm 2\sigma$ of the data.

c Uncertainty is reported as twice the propagated error of the quarterly means.

d Data are not available due to missing or damaged TLD.

e Location removed

f Insufficient data to calculate the annual dose at this location

g New location not deployed

h Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

Table 12-3. Calculated dose from TLD environmental radiation measurements, Site 300 perimeter, 2000

Location ^(a)	Quarterly dose (mSv) ^(b)				Annual dose ^(c) (mSv)
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	
3-078-TD	0.153 ± 0.004	0.145 ± 0.002	0.149 ± 0.008	0.148 ± 0.007	0.595 ± 0.006
3-081-TD	0.184 ± 0.004	0.170 ± 0.006	0.166 ± 0.021	0.177 ± 0.014	0.697 ± 0.015
3-082-TD	0.163 ± 0.003	—(d)	0.161 ± 0.006	—(e)	0.324 ± 0.002
3-085-TD	0.172 ± 0.012	—(d)	—(e)	—(e)	—(f)
3-086-TD	0.171 ± 0.009	—(d)	—(e)	—(e)	—(f)
3-088-TD	0.175 ± 0.005	0.162 ± 0.005	0.169 ± 0.013	0.175 ± 0.016	0.681 ± 0.012
3-089-TD	0.184 ± 0.006	—(d)	0.173 ± 0.006	0.168 ± 0.005	0.525 ± 0.016
3-091-TD	0.172 ± 0.010	—(d)	0.166 ± 0.016	0.182 ± 0.003	0.520 ± 0.016
3-121-TD	0.180 ± 0.003	—(d)	—(e)	—(e)	—(f)
3-123-TD	—(g)	—(g)	0.133 ± 0.002	0.143 ± 0.012	0.276 ± 0.014
3-124-TD	—(g)	—(g)	0.132 ± 0.007	0.140 ± 0.009	0.272 ± 0.011
3-125-TD	—(g)	—(g)	0.143 ± 0.023	0.141 ± 0.006	0.284 ± 0.002
3-126-TD	—(g)	—(g)	—(g)	0.161 ± 0.006	—(f)
Mean^(h)	0.172 ± 0.006	0.159 ± 0.014	0.154 ± 0.010	0.159 ± 0.012	0.644 ± 0.007

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See main volume, **Figure 12-3**, for locations.

b Measurement uncertainty is reported as $\pm 2\sigma$ of the data.

c Uncertainty is reported as twice the propagated error of the quarterly means.

d Six of nine Site 300 perimeter samples were lost due to fire.

e Location not redeployed after fire

f Insufficient data to calculate the annual dose to this location

g New location not deployed

h Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

Table 12-4. Calculated dose from TLD environmental radiation measurements, Tracy and other off-site locations in the vicinity of Site 300, 2000

Location ^(a)	Quarterly dose (mSv) ^(b)				Annual dose ^(c) (mSv)
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	
3-092-TD	0.156 ± 0.002	0.144 ± 0.011	0.150 ± 0.012	0.166 ± 0.013	0.616 ± 0.018
3-093-TD	0.157 ± 0.008	0.133 ± 0.004	0.135 ± 0.009	0.142 ± 0.009	0.567 ± 0.021
Mean^(d)	0.156 ± 0.001	0.138 ± 0.010	0.142 ± 0.014	0.154 ± 0.023	0.590 ± 0.008
3-090-TD	0.179 ± 0.017	— ^(e)	0.188 ± 0.007	0.182 ± 0.006	0.549 ± 0.009
3-094-TD	0.220 ± 0.008	— ^(e)	0.220 ± 0.011	0.227 ± 0.006	0.667 ± 0.008
3-096-TD	0.202 ± 0.030	— ^(e)	0.200 ± 0.014	0.192 ± 0.016	0.594 ± 0.010
3-099-TD	0.145 ± 0.005	0.140 ± 0.004	0.148 ± 0.006	0.137 ± 0.007	0.570 ± 0.010
Mean^(d)	0.186 ± 0.032	— ^(f) ± — ^(g)	0.189 ± 0.030	0.184 ± 0.037	0.559 ± 0.002

Note: Measurement represents the TLD absorbed dose in mR converted to mSv.

a See main volume, **Figure 12-3**, for locations.

b Measurement uncertainty is reported as $\pm 2\sigma$ of the data.

c Uncertainty is reported as twice the propagated error of the quarterly means.

d Uncertainty associated with the quarterly means is reported as two standard errors of the location data.

e Three of four off-site samples were lost due to fire.

f Insufficient number of samples to calculate mean

g Insufficient number of samples to calculate uncertainty

**There are no supplemental data in this chapter.
Please see the main volume for details about
Radiological Dose Assessment.**

QUALITY ASSURANCE

Lucinda M. Clark

Laboratory Intercomparison Studies

Two laboratories at Lawrence Livermore National Laboratory participated in the annual Environmental Monitoring Laboratory (EML) intercomparison studies program sponsored by the U.S. Department of Energy (DOE). The two LLNL laboratories are the Chemistry and Materials Science Environmental Services' (CES) Environmental Monitoring Radiation Laboratory (EMRL) and the Hazards Control Department's Analytical Laboratory (HCAL).

The results of CES EMRL's participation in the EML studies are presented in Table 14-1. According to the results, 45 of 46 analyses fell within established acceptance control limits. Corrective action to resolve this problem is currently being developed and implemented.

The results of HCAL's participation in the 2000 EML studies (see Table 14-2) indicate that 10 of 10 sample results fell within the 3σ acceptance control limits.

CES EMRL participated in two DOE Mixed Analyte Performance Evaluation Program (MAPEP) studies in 2000. The results of these study are presented in Tables 14-3 and 14-4. Of the analyses reported by CES in these studies, 21 of 22 fell within acceptable limits. A false positive result for plutonium-238 in soil was reported in the MAPEP-00-S7 study. Corrective action to resolve this problem is currently being developed and implemented.

Although contract laboratories are also required to participate in laboratory intercomparison programs, permission to publish their results for comparison purposes was not granted for 2000.

**Table 14-1. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 2000**

Analyte	EML study	CES value	EML value	CES/EML	Control limits (3σ) ^(a)	Warning limits (2σ)	Performance ^(b)
Air filter (Bq/filter)							
Am-241	608	.092	.088	1.05	0.73–2.58	0.88–1.46	Acceptable
Co-57	608	6.83	5.31	1.29	0.65–1.39	0.72–1.13	Warning
	611	18.8	14.6	1.29	0.69–1.37	0.89–1.14	Warning
Co-60	608	6.57	5.32	1.24	0.75–1.32	0.83–1.10	Warning
	611	10.0	8.43	1.19	0.79–1.30	0.87–1.13	Warning
Cs-137	608	7.91	6.10	1.30	0.73–1.37	0.82–1.14	Warning
	611	9.62	7.41	1.30	0.78–1.35	0.88–1.16	Warning
Mn-54	608	35.6	27.2	1.31	None	None	Warning
	611	56.6	43.2	1.31	0.80–1.36	0.89–1.20	Warning
Pu-238	608	0.077	0.080	0.958	0.74–1.40	0.89–1.15	Acceptable
	611	0.045	0.045	1.00	0.66–1.35	0.88–1.12	Acceptable
Pu-239	608	0.087	0.089	0.973	0.76–1.44	0.90–1.19	Acceptable
	611	0.071	0.074	0.958	0.69–1.29	0.89–1.13	Acceptable
U-234	608	0.058	0.062	0.931	0.83–1.92	0.90–1.40	Acceptable
U-238	608	0.056	0.062	0.910	0.84–2.61	0.90–1.31	Acceptable
Soil (Bq/kg)							
Ac-228	608	3.01	3.36	0.896	0.79–1.75	0.87–1.31	Acceptable
Am-241	611	7.39	8.27	0.894	0.63–2.31	0.79–1.48	Acceptable
Cs-137	608	299	339	0.882	0.83–1.32	0.90–1.21	Warning
	611	863	1020	0.846	0.80–1.29	0.90–1.18	Warning
K-40	608	805	811	0.993	0.78–1.53	0.90–1.25	Acceptable
	611	676	713	0.948	0.80–1.37	0.90–1.23	Acceptable
Pu-239	608	6.86	7.00	0.980	0.69–1.74	0.89–1.24	Acceptable
	611	17.3	16.8	1.03	0.71–1.33	0.87–1.16	Acceptable
U-234	608	111	111	1.00	0.47–1.30	0.70–1.11	Acceptable
U-238	608	114	114	1.00	0.44–1.42	0.69–1.10	Acceptable

Table 14-1. LLNL's CES EMRL results from the DOE EML Quality Assurance Program, 2000 (concluded)

Analyte	EML study	CES value	EML value	CES/EML	Control limits (3 σ) ^(a)	Warning limits (2 σ)	Performance ^(b)
Vegetation (Bq/kg)							
Am-241	608	9.90	10.4	0.952	0.68–2.70	0.89–1.60	Acceptable
Cm-244	608	6.80	5.00	1.360	0.47–1.74	0.81–1.35	Warning
Co-60	608	49.7	52.8	0.941	0.69–1.46	0.86–1.24	Acceptable
Cs-137	608	1270	1380	0.920	0.80–1.40	0.90–1.25	Acceptable
K-40	608	542	521	1.040	0.79–1.42	0.90–1.24	Acceptable
Pu-239	608	12.8	15.5	0.826	0.66–7.94	0.81–2.89	Warning
	611	8.75	9.60	0.911	0.67–1.49	0.85–1.16	Acceptable
Water (Bq/L)							
Am-241	608	1.91	1.95	0.979	0.75–1.49	0.90–1.24	Acceptable
	611	1.55	1.19	1.30	0.76–1.48	0.90–1.22	Warning
Co-60	608	53.9	48.9	1.102	0.80–1.20	0.90–1.14	Acceptable
	611	74.5	73.7	1.01	0.80–1.20	0.90–1.12	Acceptable
Cs-137	608	112	103	1.087	0.80–1.26	0.90–1.18	Acceptable
	611	70.1	67.0	1.05	0.80–1.24	0.90–1.15	Acceptable
H-3	608	86.3	79.4	1.087	0.71–1.79	0.82–1.22	Acceptable
	611	121	91.3	1.33	0.74–2.29	0.84–1.31	Warning
Pu-238	608	0.943	0.944	0.999	0.78–1.25	0.90–1.11	Acceptable
	611	0.950	0.786	1.21	0.74–1.22	0.90–1.10	Warning
Pu-239	608	0.940	0.918	1.02	0.80–1.39	0.90–1.15	Acceptable
	611	0.812	0.591	1.37	0.75–1.26	0.90–1.11	Not Acceptable
U-234	608	0.460	0.482	0.954	0.80–1.40	0.90–1.22	Acceptable
U-238	608	0.444	0.492	0.902	0.80–1.26	0.90–1.17	Acceptable

a Control limits are established from historical Quality Assurance Program data and reported as the ratio of reported value to EML value. Limits were not applied where historical data were insufficient.

b Data are considered acceptable when they fall within the 2 σ warning limits. Data should be checked for error when they are between the 2 σ warning limits and the 3 σ control limits. Data are considered unacceptable when they are outside the 3 σ control limits.

**Table 14-2. LLNL's HCAL results from the DOE EML Quality Assurance Program, 2000**

Analyte	EML study	HCAL value	EML value	HCAL/EML	Control limits (3σ)	Warning limits (2σ)	Performance ^(a)
Air filter (Bq/filter)							
Gross alpha	608	2.15	3.02	0.712	0.50–1.55	0.81–1.32	Warning
	611	2.21	2.35	0.940	0.57–1.47	0.83–1.24	Acceptable
Gross beta	608	1.84	2.42	0.760	0.72–1.67	1.89–1.39	Warning
	611	1.23	1.52	0.810	0.76–1.52	0.88–1.29	Warning
Water (Bq/L)							
Gross Alpha	608	1700	1700	1.001	0.61–1.32	0.83–1.17	Acceptable
	611	1210	1070	1.13	0.58–1.26	0.79–1.12	Warning
Gross Beta	608	936	690	1.36	0.55–1.54	0.71–1.32	Warning
	611	1079	950	1.13	0.56–1.50	0.75–1.33	Acceptable
Tritium	608	76.1	79.4	0.958	0.71–1.79	0.82–1.22	Acceptable
	611	100	91.3	1.10	0.74–2.29	0.84–1.31	Acceptable

a Data are considered acceptable when they fall within the 2σ warning limits. Data should be checked for error when they are between the 2σ warning limits and the 3σ control limits. Data are considered unacceptable when they are outside the 3σ control limits.

Table 14-3. LLNL CES EMRL performance in the MAPEP-00-S7 Intercomparison Program for Soil

Analyte	CES value	Units	Reference value	Bias (%)	Acceptance range	Performance ^(a)
Americium-241	60.1	Bq/kg	61.1	-1.6	42.8–79.4	Acceptable
Cesium-134	832	Bq/kg	1047	-20.5	732–1360	Warning
Cesium-137	904	Bq/kg	930	-2.8	651–1210	Acceptable
Cobalt-57	976	Bq/kg	949	2.8	664–1230	Acceptable
Cobalt-60	1230	Bq/kg	1180	4.2	826–1530	Acceptable
Manganese-54	1090	Bq/kg	1023	6.5	716–1330	Acceptable
Plutonium-238	0.530	Bq/kg	n/a ^(b)	n/a	n/a	False Positive
Plutonium-239/240	72.7	Bq/kg	74.4	-2.3	52.1–96.7	Acceptable
Potassium-40	741	Bq/kg	652	13.6	456–848	Acceptable
Uranium-234/233	76.8	Bq/kg	90	-14.7	63.0–117	Acceptable
Uranium-238	79.5	Bq/kg	93	-14.5	65.1–121	Acceptable
Zinc-65	1790	Bq/kg	1540	16.2	1080–2000	Acceptable

a Acceptable results have $| \text{bias} | \leq 20\%$. Results with warning have $20\% < | \text{bias} | \leq 30\%$.

b n/a = not applicable

Table 14-4. LLNL CES EMRL performance in the MAPEP-99-W7 Intercomparison Program for Water

Analyte	CES value	Units	Reference value	Bias (%)	Acceptance range	Performance ^(a)
Americium-241	0.669	Bq/L	0.635	5.4	0.44–0.83	Acceptable
Cesium-137	71.5	Bq/L	72.7	-1.7	50.9–94.5	Acceptable
Cobalt-57	98.9	Bq/L	96.8	2.2	67.8–126	Acceptable
Cobalt-60	276	Bq/L	270	2.2	189–351	Acceptable
Manganese-54	401	Bq/L	395	1.5	277–514	Acceptable
Plutonium-238	0.318	Bq/L	0.32	-0.6	0.22–0.42	Acceptable
Plutonium-239/240	0.00679	Bq/L	n/a ^(b)	n/a	n/a	False Positive
Uranium-234/233	0.442	Bq/L	0.428	3.3	0.30–0.56	Acceptable
Uranium-238	0.445	Bq/L	0.444	0.2	0.31–0.58	Acceptable
Zinc-65	256	Bq/L	220	16.4	154–286	Acceptable

a Acceptable results have | bias | \leq 20%. Results acceptable with warning have | bias | $>$ 20% less but \leq 30%.

b n/a = not applicable

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